

Chapter 3

Preliminary Data Analysis

In this chapter we describe the preliminary data analysis for our study. We begin with a description of the database structure. Next we show frequency distributions of the basic variables of interest. Finally we show graphs and tables summarizing the associations between the determinants and the outcomes.

3.1 Description of the Database

Figure 3.1 shows the structure of the database. The data are stored in MS Access as two tables, *student* and *behaviour*. The *student* table has a record for each student, indexed by an ID field, and contains demographic information about the students. The *behaviour* table contains their responses to the 42 questionnaire items. Since each response item has data of the same type (i.e., an integer from 1 to 5 giving the student's response to the specified questionnaire item), these data are stored as separate records for each combination of student and item, and thus has the composite index (ID, item).

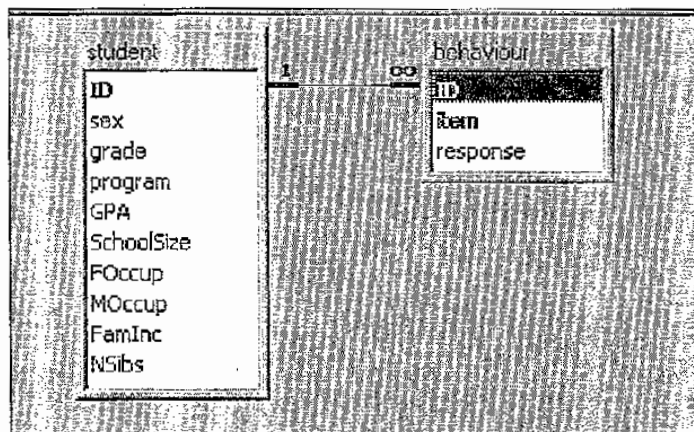


Figure 3.1: Relational database structure

3.2 Summary of Student Data

Figure 3.2 shows the distribution of the nine determinant variables. This result shows the numerical summaries and histograms of these variables for 196 high school students in Songkhla province, Thailand. The mean and standard deviations are not particularly meaningful.

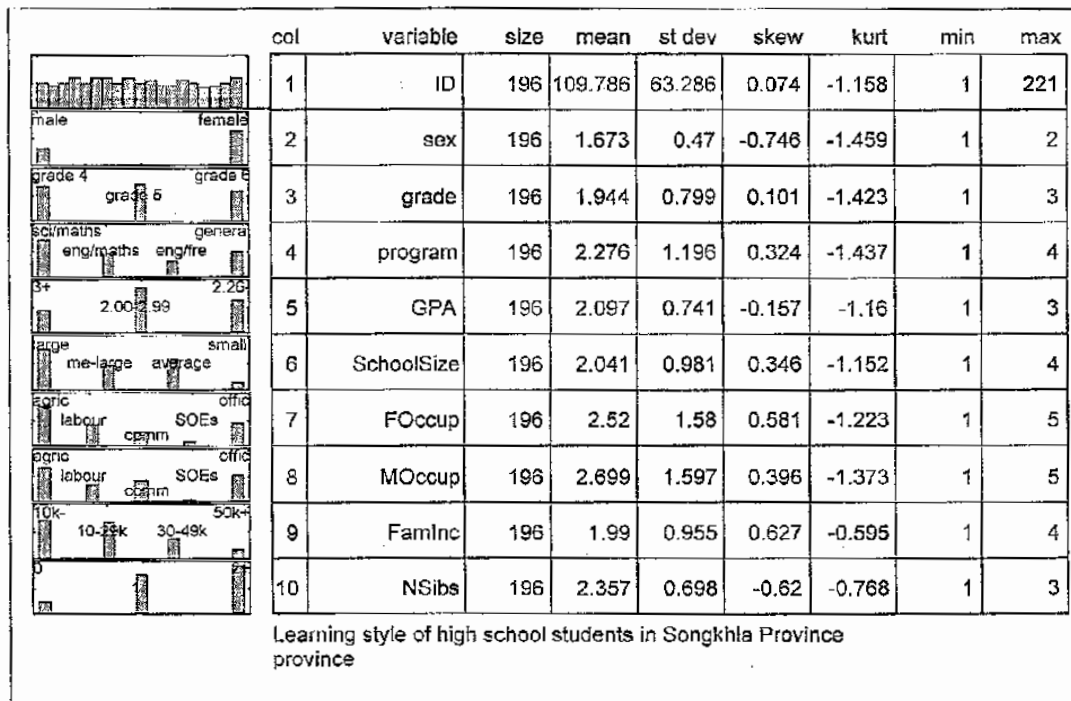


Figure 3.2: Summaries of demographic variables

Table 3.1 shows the detailed distributions of each determinant. A total of 132 students (67.4%) were female, and 64 were male. The percentages in grade 4, 5 and 6 were approximately the same. The program composition of students comprised 36.7% Science-Mathematics, 23.5% English-Mathematics, 15.3% English-French and 14.5% General. For grade point average (GPA), 37.3% were between 2.0-2.99, 32.6% less than 2.0 and 23.0% 3.0 or more. 39.3% students were at large schools, 30.1% at average schools, 24.0% at medium-large schools and 6.65% at small schools. The father's occupation composition of students comprised 38.8% in agriculture, 20.4% labour, 17.4% officials and 13.8% commerce. For mother's occupation 34.2% were in agriculture, 20.9% commerce, 16.8% labour and 12.3% officials. Almost 37% had family incomes less than 10,000 baht/month, 34.2% between 10,000-29,000 baht/month, 18.9% between 30,000-49,000 baht/month, and 8.7% more than 50,000

baht/month. 48.5% had more than one sibling, 37.8% had one, and 12.8% had no brothers or sisters.

Determinant	Category	Count	Percentage
Gender	Male	64	32.65
	Female	132	67.35
Grade	Grade 4	68	34.69
	Grade 5	71	36.22
	Grade 6	57	29.08
Program	Science/Maths	72	36.73
	English/Maths	46	23.47
	English/French	30	15.31
	General	48	14.19
GPA.	3.0 ⁺	45	22.96
	2.0-2.99	87	44.38
	2.0-	64	32.65
School Size	Large	77	39.28
	Medium-Large	47	23.98
	Average	59	30.10
	Small	13	6.63
Father's Occupation	Agriculture	76	38.78
	Labour	40	20.41
	Commerce	27	13.78
	SOEs	8	4.08
	Official	34	17.35
	Other	11	5.61
Mother's Occupation	Agriculture	67	34.18
	Labour	33	16.84
	Commerce	41	20.92
	SOEs	2	1.02
	Official	24	1.24
	Other	29	14.80
Family Income	10,000 ⁻	73	37.25
	10,000-29,000	69	35.20
	30,000-49,000	37	18.88
	50,000 ⁺	17	8.67
Number of brothers & sisters	0	25	12.76
	1	76	38.78
	2 ⁺	95	48.47

Table 3.1 Distribution of students by determinant variables

3.3 Summary of Questionnaire Responses

The questionnaire is composed of 42 items. These items are grouped into six learning styles as follows:

Learning style 1 (Independent):

- Q1: I am confident that I can learn every subject.
- Q7: I do every assessment successfully on my own.
- Q13: I can decide which topic is important.
- Q19: I choose to learn only more interesting topics.
- Q25: I always work by myself before class.
- Q31: I always seek for other knowledge by myself.
- Q37: I know best what I should do in every subject.

Learning style 2 (Avoidance):

- Q2: I feel bored during classroom activities.
- Q8: I rejoice when the lesson is cancelled.
- Q14: I never give any attention to some subjects.
- Q20: I don't like the teacher asking me questions.
- Q26: The subjects we learn are not useful in practice.
- Q32: I attend classes only because of duty.
- Q38: Answering questions, I avoid the teacher's eyes.

Learning style 3 (Collaborative):

- Q3: I prefer group rather than individual activities.
- Q9: I learn better discussing with my classmates.
- Q15: Group learning helps me with social interaction.
- Q21: I prefer discussing topics outside the classroom.
- Q27: I prefer teachers who encourage students.
- Q33: My friend's help me understand my work better.
- Q39: I try to achieve the best teamwork outcomes.

Learning style 4 (Dependent):

- Q4: The text books are enough for my learning.
- Q10: I try to do every assignment.
- Q16: I prefer exams that come from the textbook.
- Q22: I ask the teacher before doing any activities.
- Q28: I don't like activities not covered in text books.
- Q34: The teacher is the best person to plan things.
- Q40: Teachers shouldn't encourage students opinions.

Learning style 5 (Competitive):

- Q5: I am very glad when I score better than others.
- Q11: I try to solve problems at the first attempt.
- Q17: I have to compete to achieve my score.
- Q23: I need to show everybody my best score.
- Q29: I try to do activities rapidly and finish first.
- Q35: I must compete for the teacher's attention.
- Q41: I like to help other students without reward.

Learning style 6 (Participant):

- Q6: I always give my opinion in the classroom.
- Q12: I always learn something in every class.
- Q18: I don't like to be absent from class & miss work.
- Q24: I do my best in all activities.
- Q30: When I get the schoolwork I do it immediately.
- Q36: Classroom activities are very interesting.
- Q42: I try to the best of my ability in every subject.

Figure 3.3 shows the numerical summaries and histograms of these outcomes for the 196 responses sampled from high school students in Songkhla province.

The responses were multiple choices as follows:

1: never, 2: sometimes, 3: moderately, 4: often, 5: always

The mean and standard deviation may not be the most appropriate measures, given the ordinal rather than interval nature of this outcome variable. However, the results show the highest scores for items 15 ("Group learning helps me to be responsible for social interaction") and 16 ("I prefer exams that come from the text books"). And the lowest scores were obtained for items 38 ("I will not look at the teacher's eyes when I'm answering a question") and 40 ("I think teachers who encourage student's opinions are the worst").

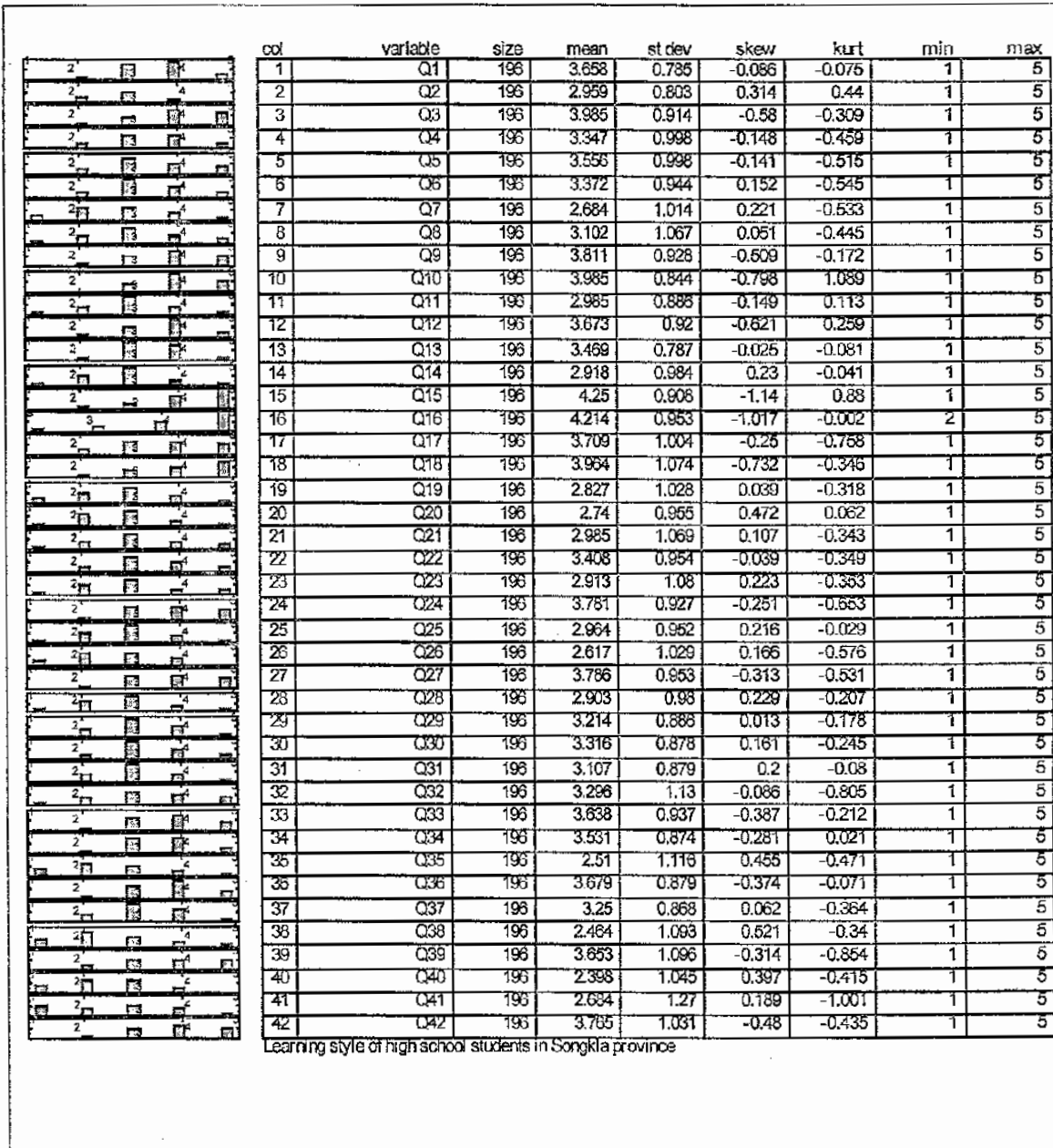


Figure 3.3: Histograms and numerical summaries of response variables

3.4 Factor Analysis

Factor analysis is used to reduce the number of outcome variables. There are 196 observations corresponding to the 42 questionnaire items in these data. In this analysis missing values are replaced by the median value for each response. We tried fitting 5, 6, 7, 8 and 9 factors, using maximum likelihood. Table 3.2 shows the results for the goodness-of-fit tests in each case. We see that good fits result, in the sense that the p-values are greater than 0.05, from the models with 8 and 9 factors. However, even

though the errors still contain information, the model with only five factors is most easily interpretable. For this reason we have selected this model for further analysis.

Number of factors	Chi-Squared	df	p-value
5	802.24	661	0.0001
6	722.88	624	0.0037
7	653.16	588	0.0319
8	588.08	553	0.1460
9	531.29	519	0.3449

Table 3.2: Results for goodness-of-fit tests of factor models

The validation of the questionnaire among the students is shown in the reliability analysis in Table 3.3. There were only two items with questionable reliability, and omitting them from their factor group causes Cronbach's alpha coefficient to increase slightly.

The factor loadings for each questionnaire item after *varimax* rotation of the factors are shown in Table 3.4. Loadings having magnitudes less than 0.2 are omitted from this table, except for item 3 where no loading exceeds this amount. Higher loadings are highlighted with shading. The factor analysis thus clusters the items into five groups, where each group comprises a different set of questions. After omitting the two unreliable items, the results from the factor analysis are as shown in Table 3.5 (sorted by loading).

Factor	Initial alpha	Omitted Item	Final alpha
1	0.7375	3	0.7522
2	0.7074	32	0.7196
3	0.6891	-	0.6891
4	0.5826	-	0.5826
5	0.5921	-	0.5921

Table 3.3 Reliability analysis for 5 factors with 42 items.

Questionnaire Item	Factor				
	1	2	3	4	5
1. I am confident that I can learn every subject.	0.670				0.228
2. I feel bored during classroom activities.				0.366	
3. I prefer group rather than individual activities.	0.162				0.156
4. The text books are enough for my learning.					0.376
5. I am very glad when I score better than others.	0.339			0.279	
6. I always give my opinion in the classroom.	0.611				
7. I do every assessment successfully on my own.			0.304		
8. I rejoice when the lesson is cancelled.				0.558	
9. I learn better discussing with my classmates.	0.482	0.324			
10. I try to do every assignment.	0.412				0.310
11. I try to solve problems at the first attempt.	0.344				
12. I always learn something in every class.	0.338				0.388
13. I can decide which topic is important.	0.350	0.261			
14. I never give any attention to some subjects.				0.546	
15. Group learning helps me with social interaction.	0.270				0.318
16. I prefer exams that come from the textbook.					0.442
17. I have to compete to achieve my score.		0.302			
18. I don't like to be absent from class & miss work.	0.266	0.430			
19. I choose to learn only more interesting topics.			0.379	0.314	
20. I don't like the teacher asking me questions.			0.288	0.409	
21. I prefer discussing topics outside the classroom.		0.394	0.304		
22. I ask the teacher before doing any activities.		0.321			
23. I need to show everybody my best score.				0.442	
24. I do my best in all activities.	0.425				
25. I always work by myself before class.		0.507	0.522		
26. The subjects we learn are not useful in practice.			0.485	0.301	
27. I prefer teachers who encourage students.	0.436				
28. I don't like activities not covered in text books.			0.313		
29. I try to do activities rapidly and finish first.		0.354			
30. When I get the schoolwork I do it immediately.		0.474			
31. I always seek for other knowledge by myself.		0.439	0.275		
32. I attend classes only because of duty.		0.200			
33. My friend's help me understand my work better.		0.299			
34. The teacher is the best person to plan things.					0.585
35. I must compete for the teacher's attention.			0.539	0.289	
36. Classroom activities are very interesting.		0.524			
37. I know best what I should do in every subject.	0.293				
38. Answering questions, I avoid the teacher's eyes.			0.333	0.315	
39. I try to achieve the best teamwork outcomes.		0.439		0.295	
40. Teachers shouldn't encourage students opinions.			0.562		
41. I like to help other students without reward.			0.489		
42. I try to the best of my ability in every subject.	0.363	0.407			

Table 3.4: Varimax-rotated loadings greater than 0.2 for the five-factor model

Questionnaire Item	Factor				
	1	2	3	4	5
36. Classroom activities are very interesting.	0.517				0.306
39. I try to achieve the best teamwork outcomes.	0.517			0.302	
42. I try to the best of my ability in every subject.	0.451	0.326			
30. When I get the schoolwork I do it immediately.	0.444				
31. I always seek for other knowledge by myself.	0.430				
18. I don't like to be absent from class & miss work.	0.416	0.262			
21. I prefer discussing topics outside the classroom.	0.406		0.343		
33. My friend's help me understand my work better.	0.340				
29. I try to do activities rapidly and finish first.	0.335		0.204		
22. I ask the teacher before doing any activities.	0.321				
1. I am confident that I can learn every subject.		0.690			
6. I always give my opinion in the classroom.	0.241	0.587			
9. I learn better discussing with my classmates.		0.447			
27. I prefer teachers who encourage students.	0.246	0.438			
24. I do my best in all activities.	0.304	0.409			
10. I try to do every assignment.		0.398			
5. I am very glad when I score better than others.		0.346		0.274	
13. I can decide which topic is important.		0.320			
11. I try to solve problems at the first attempt.		0.310	0.259		
37. I know best what I should do in every subject.	0.234	0.258			
35. I must compete for the teacher's attention.			0.559	0.247	
25. I always work by myself before class.	0.506		0.548		
40. Teachers shouldn't encourage students opinions.			0.532		
41. I like to help other students without reward.			0.487		
26. The subjects we learn are not useful in practice.			0.481	0.281	
19. I choose to learn only more interesting topics.			0.414	0.282	
38. Answering questions, I avoid the teacher's eyes.			0.330	0.301	
7. I do every assessment successfully on my own.			0.330		
28. I don't like activities not covered in text books.			0.313		
8. I rejoice when the lesson is cancelled.				0.567	
14. I never give any attention to some subjects.				0.532	
23. I need to show everybody my best score.				0.426	0.233
20. I don't like the teacher asking me questions.			0.291	0.388	
2. I feel bored during classroom activities.				0.359	
34. The teacher is the best person to plan things.					0.623
16. I prefer exams that come from the textbook.					0.421
12. I always learn something in every class.	0.327				0.420
4. The text books are enough for my learning.					0.355
15. Group learning helps me with social interaction.		0.256			0.311
17. I have to compete to achieve my score.	0.246				0.258

Table 3.5: Varimax-rotated loadings greater than 0.2 for the five-factor model, sorted

The questionnaire items are thus grouped into factors as follows.

1. Q18: I don't like to be absent from class and miss work.
 Q21: I prefer discussing topics outside the classroom.
 Q22: I ask the teacher before doing any activities.
 Q29: I try to do activities rapidly and finish first.
 Q30: When I get the schoolwork I do it immediately.
 Q31: I always seek for other knowledge by myself.
 Q33: My friend's help me understand my work better.
 Q36: Classroom activities are very interesting.
 Q39: I try to achieve the best teamwork outcomes.
 Q42: I try to the best of my ability in every subject.
2. Q1: I am confident that I can learn every subject.
 Q5: I am very glad when I score better than others.
 Q6: I always give my opinion in the classroom.
 Q9: I learn better discussing with my classmates.
 Q10: I try to do every assignment.
 Q11: I try to solve problems at the first attempt.
 Q13: I can decide which topic is important.
 Q24: I do my best in all activities.
 Q27: I prefer teachers who encourage students.
 Q37: I know best what I should do in every subject.
3. Q7: I do every assessment successfully on my own.
 Q19: I choose to learn only more interesting topics.
 Q25: I always work by myself before class.
 Q26: The subjects we learn are not useful in practice.
 Q28: I don't like activities not covered in text books.
 Q35: I must compete for the teacher's attention.
 Q38: Answering questions, I avoid the teacher's eyes.
 Q40: Teachers shouldn't encourage students opinions.
 Q41: I like to help other students without reward.
4. Q2: I feel bored during classroom activities.
 Q8: I rejoice when the lesson is cancelled.
 Q14: I never give any attention to some subjects.
 Q20: I don't like the teacher asking me questions.
 Q23: I need to show everybody my best score.
5. Q4: The text books are enough for my learning.
 Q12: I always learn something in every class.
 Q15: Group learning helps me with social interaction.
 Q16: I prefer exams that come from the textbook.
 Q17: I have to compete to achieve my score.
 Q34: The teacher is the best person to plan things.

From the results we can see that all the questions in factor one indicate that students are cooperative to the learning style. Therefore we named factor one “*Collaborative*”. All the questions in factor two are related to students being optimistic about learning. Therefore we named this factor “*Like to learn*”. All questions in factor three indicate that students are independent. Therefore we named this factor “*Independent*”. All questions in factor four indicate that students are pessimistic about learning. Therefore we named this factor “*Hates to learn*”. All questions in factor five indicate that students are not producing original ideas about learning. Therefore we named this factor five “*Not creative*”.

Based on these results, we created five indexes by taking the average score for each student based on all the items in each of the five factors. Next we look at the relationships between these indexes, as shown in Figure 3.4. We can see that the *like to learn* factor and *collaborative* factor have the strongest relationship (correlation coefficient $r = 0.583$) and *hate to learn* factor and *collaborative* factor have the weakest relationship ($r = -0.057$).

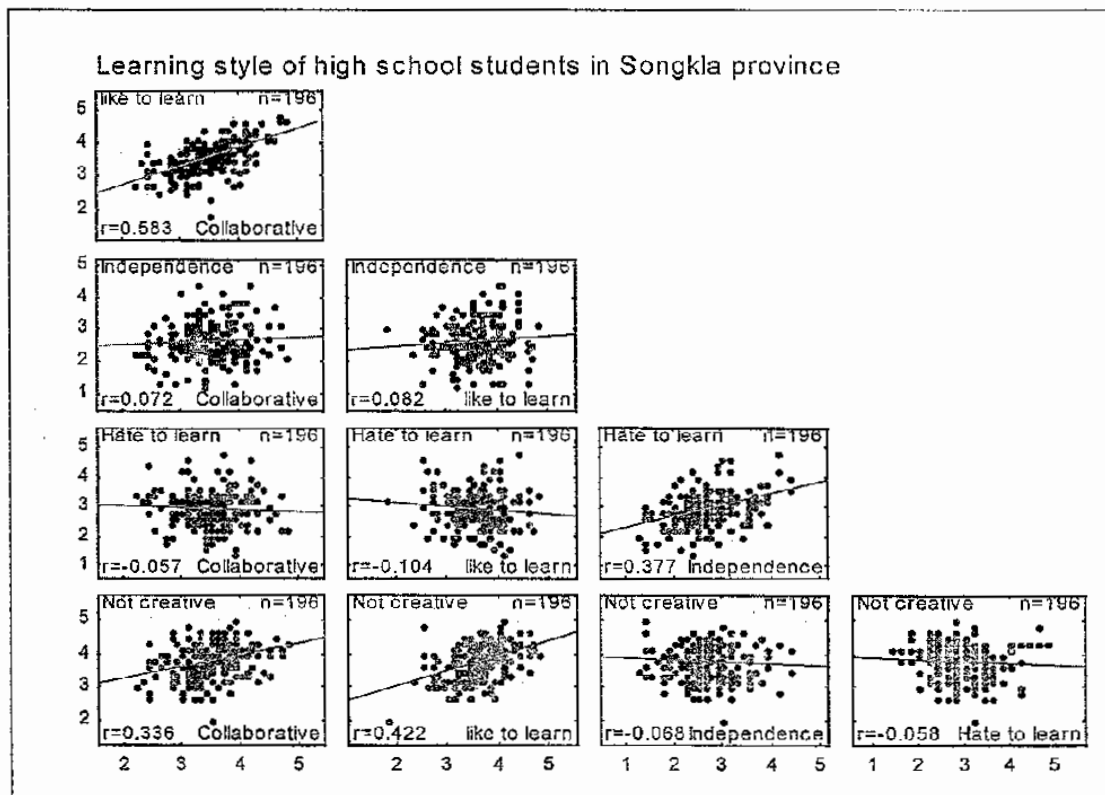


Figure 3.4: Scatterplot matrix showing relation between each pair of factor indexes

3.5 Comparison Between Each Factor and Each Determinant

Next we will look at the comparison between each factor and each determinant using one-way anova.

Table 3.6 shows a summary of the p-values from the one-way anova comparing each of the six outcome factors (obtained from the factor analysis) and each of the nine determinants. First, we see that *program* is important for the *collaborative* and *hate to learn* factors. Second, *grade* is important for the *like to learn* factor. Finally, *GPA* is important for the *independent* factor and *school size* is important for the *not creative* factor.

Factor	Sex	Grade	Program	GPA	School size	Father's Occupation	Mo's Occupation	Family Income	No. of brother-sister
Collaborative	0.739	0.154	0.022	0.571	0.526	0.872	0.393	0.058	0.229
Like to learn	0.120	0.035	0.722	0.084	0.769	0.639	0.114	0.569	0.104
Independent	0.097	0.329	0.001	0.0003	0.024	0.157	0.748	0.142	0.068
Hate to learn	0.821	0.818	0.029	0.267	0.529	0.407	0.787	0.583	0.947
Not creative	0.212	0.767	0.921	0.500	0.090	0.773	0.426	0.091	0.594

Table 3.6: p-value of each factor variable and each determinant

Next, we show confidence intervals and box plots for these comparisons. Figure 3.4 shows the one-way anova analysis of *collaborative* learning style with program. Pairs of means with p-values greater than 0.05 based on the Kramer-Tukey multiple comparison method are joined. So we see that the only programs that show a difference with respect to the *collaborative* factor are the general and science-mathematics programs. Students taking the general program have lower *collaborative* scores than those in the science-mathematics program.

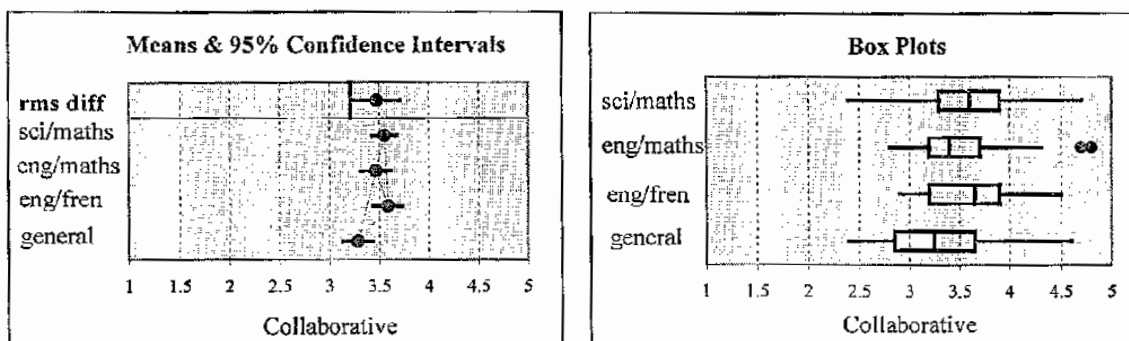


Figure 3.4: Comparison of collaborative with program

Figure 3.5 shows the determinant for the *like to learn* learning style among the students. It shows that the students in grade 4 have greater preference for the *like to learn* learning style than those in grade 6.

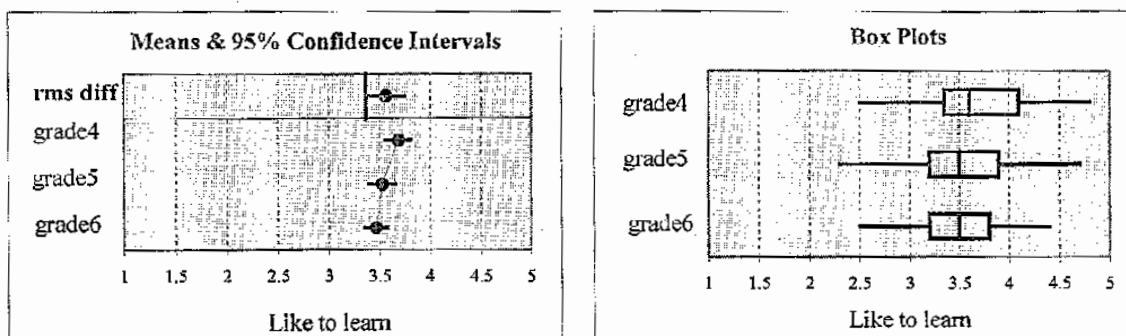


Figure 3.5: Comparison of like to learn with grade

Turning to the *independent* factor, it found that the only program that show a difference with respect to the independence factor are the english-french, english-mathematics and general program. Students taking the english-french program have lower independence score than those in the general and english-mathematics program respectively. As shown in Figure 3.6

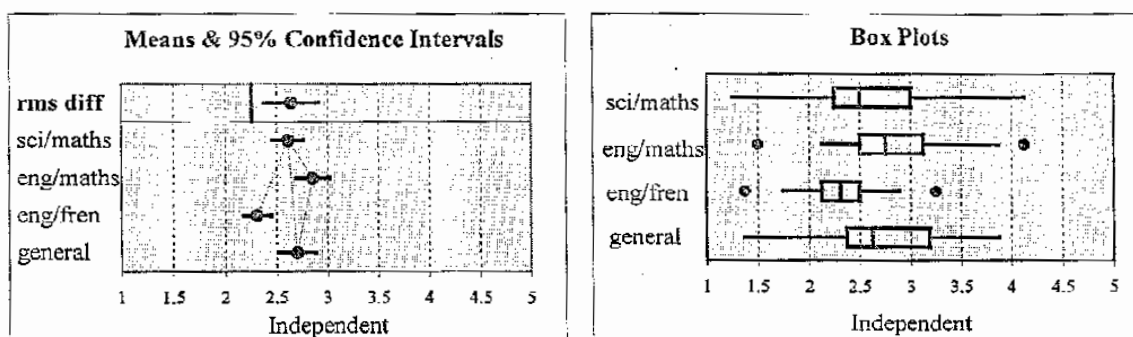


Figure 3.6: Comparison of independence with program

Figure 3.7 shows that the *independent* learning style is also determined by GPAs. The students with GPAs less than 3.00 have higher scores in this learning style and the students with GPAs of 3 or more, as shown in

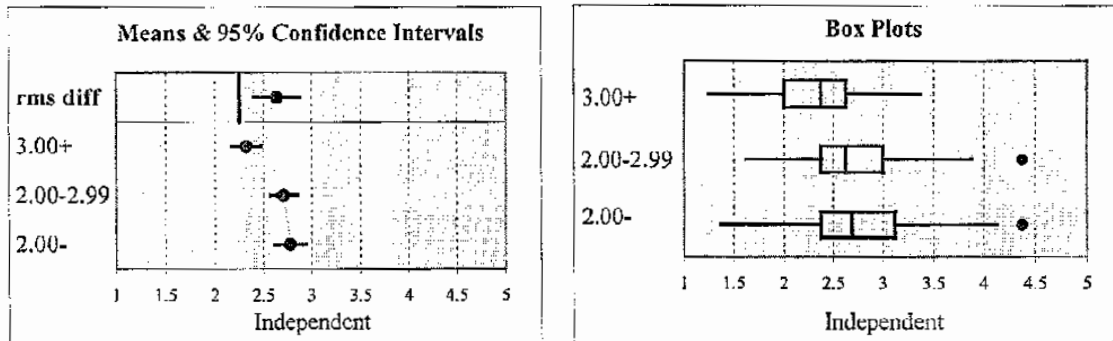


Figure 3.7: Comparison independence with GPA

Figure 3.8 shows that the *independent* learning style is also determined by the school size. While no pairwise differences achieve statistical significance according to the Kramer-Tukey criterion, there is some evidence that the scores for *independent* learning style of students in median-large and average schools are greater than the scores of the students in small and large schools.

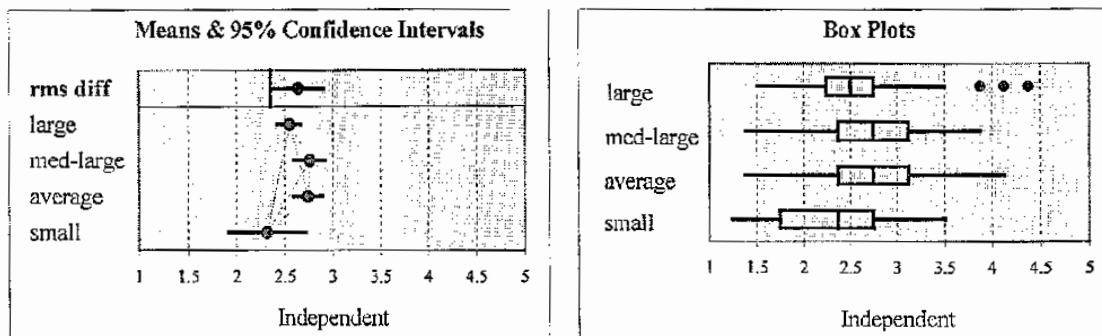


Figure 3.8: Comparison of independence with school size

Figure 3.9 shows the result for the *hate to learn* learning style of students. It shows that the students in science-mathematics program have the most hatred of learning.

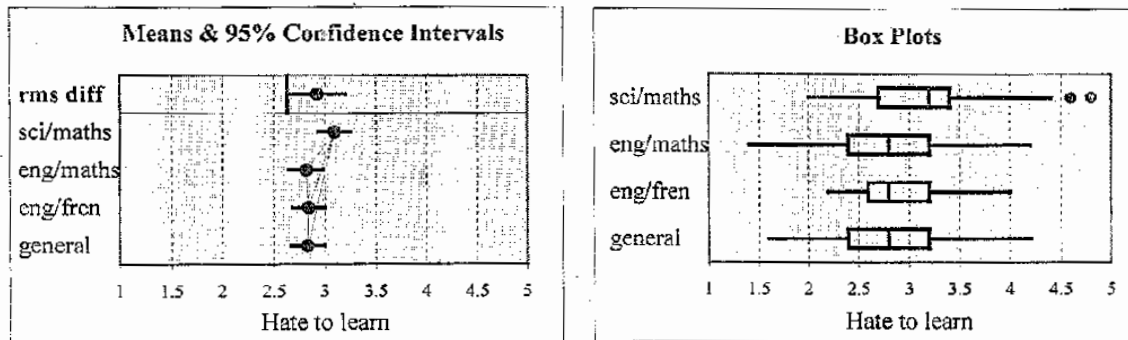


Figure 3.9: Comparison of hate to learn with program

Table 3.7 shows the comparison between each factor and each determinant adjusted for the determinant having the minimum p-value from the one-way anova. We use two-way anova for this analysis.

When we adjusted the GPA value by program, it shows that the students with GPA value less than 2.00 have hate to learn learning style greater than the group of 2.00-2.99 and 3.00 or more (Figure 3.10).

Factor /adjusted for	Sex	Grade	Pro gram	GPA	School size	Fa's Occu- pation	Mo's Occu- pation	Family Income	No.of brother - sister
Collaborative /program	0.448	0.167	-	0.958	0.365	0.946	0.659	0.246	0.296
Like to learn /grade	0.120	-	0.821	0.076	0.874	0.555	0.099	0.618	0.115
Independent /GPA	0.918	0.457	0.199	-	0.127	0.347	0.976	0.117	0.246
Hate to learn /program	0.813	0.634	-	0.040	0.437	0.204	0.489	0.662	0.977
Not creative /school size	0.076	0.714	0.294	0.140	-	0.842	0.426	0.112	0.678

Table 3.7: P-value of each factor & determinant adjusted for most significant covariate

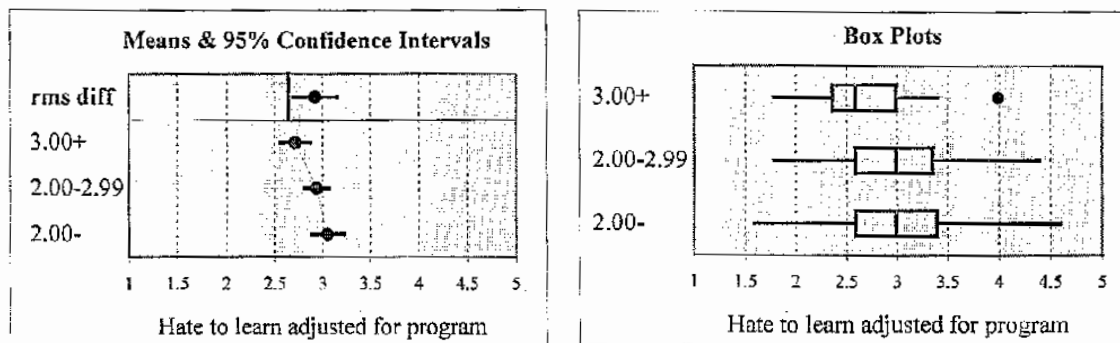


Figure 3.10: Comparison of hate to learn with GPA adjusted for program

Our findings may be summarized as follows.

From the preliminary results we can group 42 items into five factors. The reliability analysis showed that two of these items could be omitted.

The factors are correlated with each other. The highest correlation is 0.58, which is between the *collaborative* and *like to learn* factors.

The program determinant is the strongest associated of any outcome factor. It is associated of both the *collaborative* and *hate to learn* factors. Students taking the general program have lower scores on the *collaborative* factor, students taking the englihs-french have lower score on the *independent* factor and students taking the science-maths have high scores on the *hate to learn* factor. After adjusting for any statistically significant covariates, only one other determinant is found to predict an outcome factor. It is found that GPA score is a predictor of the *hate to learn* style after adjusting for the effect of program, with the students with lower GPAs having higher *hate to learn* scores.