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Author(s)	Poh Sui Hoi, Rosalind Mau, Quek Khiok Seng, Cheng Yuanshan, Ng Yin Kwee and Yan Yaw Kai
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# Investigating the studying and learning approach of tertiary students in Singapore

Poh Sui Hoi, Rosalind Mau, Quek Khiok Seng, Cheng Yuanshan, Ng Yin Kwee & Yan Yaw Kai  
National Institute of Education

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## Introduction

Approaches to learning are direct descriptions of the learning process used by students. The categories used to describe approaches to learning were derived from interviews and observations of students performing normal learning tasks such as reading and understanding academic articles. Marton and Saljo (1976) identified two discrete approaches to learning related to reading articles. Students who used a surface approach concentrated on surface features of the learning task like identifying keywords or phrases. Their strategy was to memorise and reproduce elements which seem appropriate. When asked about the content of an article, they tend to give details from examples. Students who used the deep approach concentrated on the underlying meaning of an article. The strategy was to understand the real message of a piece of writing and the underlying purpose of the academic task. Thus learning approaches used by students are taken as indicators as to whether meaningful learning has occurred.

Learning approaches have a motivation and strategy element which are intimately linked (Biggs, 1979; Watkins, 1983). Students attempt to understand a topic if it is of real interest to them or they can see some relevance to their current or future roles. Students normally have a predisposition to either surface or deep approaches to learning in general. A surface approach normally is associated with limited interest in a task. The motive here is extrinsic, it is to carry out the task because of either positively or negatively reinforcing consequences. The student is willing to engage the task and pass minimally either because life will be even more unpleasant if he/she does not, or because he/she wishes to gain a paper qualification with minimal effort or trouble. A typical surface strategy is rote learning. Surface motivated students focus on what appear to be the most important topics or elements, and reproduce them. Because of this focus, they do not see interconnections between elements or meanings and implications of what is learned. The surface approach is basically used to simply get the task out of the way; to get by without failing.

A deep approach normally is associated with intrinsic motivational factors and curiosity; the strategy here flows from the curiosity to seek meaning. Deep motivation corresponds to the felt need one experiences in everyday problem solving contexts that are personally significant. In the deep approach, there is personal commitment to learning which means that the student relates the content to meaningful contexts or to existing prior knowledge, depending on the subject concerned. Deep processing involves processes of a higher cognitive level than rote learning. Study behaviour here is usually marked by wide reading, discussion with teachers and other students, playing with the task, thinking about it constantly; there is in-depth involvement with the problem, worrying about it and not letting it go.

Many studies characterised surface and deep approaches (eg. Marton & Saljo, 1976) by using qualitative research methods. Biggs (1987) added an achieving approach and developed the Study Process Questionnaire (SPQ). The achieving motive is like the surface approach in that it is focused on the product, in this case the ego trip that comes with obtaining high marks and winning prizes. The general strategy is to maximise the chances of obtaining high marks, the nature of engagement in tasks really depends on what earns the most marks. The achieving strategy concentrates on cost-effective use of time and effort; being self-disciplined, neat and systematic, planning ahead, allocating time to tasks. The element of competition may also prompt such behaviours. While at any given time surface and deep approaches are mutually exclusive, an achieving approach may be linked to either surface or deep. Surface-achievers, for instance, systematically learned selected details by rote to obtain high grades. Deep-achievers, who are often the better students, are organised and they

search for both meaning and high grades. Biggs' conceptualisation of the three approaches is summarised in Table 1 below:

Table 1: Biggs' Conceptualisation of Approaches to Learning and Studying

APPROACH	MOTIVE	STRATEGY
Surface Approach (SA)	Surface Motive (SM) is instrumental: main purpose is to meet requirements minimally: a balance between produce through rote working too hard and failing. learning.	Surface Strategy (SS) is reproductive: limit target to bare essentials and
Deep Approach (DA)	Deep Motive (DM) is intrinsic: study to actualise interest and competence in particular academic subject.	Deep Strategy (DS) is meaningful: read widely, inter-relate with previous relevant knowledge.
Achieving Approach (AA)	Achieving Motive (AM) is based upon competition and ego-enhancement: obtain highest grades, whether or not material is interesting.	Achieving Strategy (AS) is based on organising one's time and working space: behave as 'model student'.

Learning approaches are not stable psychological traits but depend upon the student's motivation and the strategy he/she adopts in meeting the tasks prevailing. It is reasonably common for students to adopt a surface approach in one course/module and a deep approach in another (eg. Laurillard, 1984; Ramsden, 1984). Many other variables such as intrinsic and extrinsic motivation, assessment procedures, teaching approaches, workload and the teaching environment were shown to have an impact on the learning approaches (See for example, Gow & Kember, 1990; Entwistle & Ramsden, 1983; Kember & Gow, 1994). Measures of approaches to learning are therefore sensitive to various contextual variables which constitute the learning and teaching environment.

Although a lot of work on the studying and learning approaches of tertiary students have been carried out elsewhere (Biggs, 1987; Ramsden & Entwistle, 1981) and also in South-East Asia (Biggs, 1991, 1992, 1993; Kember & Gow, 1990; Stokes, Balla & Stafford, 1989), very little research of this nature has been conducted in Singapore. This is the first study of this nature to be carried on a large scale, investigating Biggs' Study Process Questionnaire (SPQ) and investigating the studying and learning approaches of tertiary students in Singapore.

### The Study

This study is part of a longitudinal study of validating the SPQ for use in tertiary institutions in Singapore, investigating the different studying and learning approaches that the students here adopt towards satisfying educational goals and factors affecting the studying and learning approaches.

The SPQ consists of 42 items, seven for each of six sub-scales: surface motive (SM) and surface strategy (SS); deep motive (DM) and deep strategy (DS); achieving motive (AM) and achieving strategy (AS). Each item is in the form of a statement. Students respond to each item on a 5-point scale; whether the item is never or only rarely true, sometimes true, true about half the time, frequently true, always or almost always true. Essentially, this is a self-report scale. Main approach scales are calculated by summing scores on the respective motive-strategy sub-scales, i.e. surface approach (SA) is the sum of surface motive and surface strategy (SA=SM+SS); deep approach (DA) is the sum of deep motive and deep strategy (DA=DM+DS) and achieving approach (AA) is the sum of achieving motive and achieving strategy (AA=AM+AS). Norms have been established for the SPQ for the Hong Kong and Australian tertiary students. Here the results from the Singaporean sample will be compared to the established norms.

### Study 1 – The Case of NIE students

The sample for this Study 1 consists of the Post-Graduate Diploma in Education (PGDE) students and the Diploma in Education (Dip Ed) students in the National Institute of Education (NIE), Bukit Timah Campus, Singapore. Students in the PGDE Programme normally are graduates from universities, possessing basic undergraduate degrees in the Arts and the Sciences, mainly. Students in the Dip Ed Programme are those who graduated from the schools after obtaining their General Certificate of Education 'Advanced' Level (GCE 'A') qualification. Generally, the Dip Ed students are younger in age. The Dip Ed sample used for the study were the Dip Ed Year 2 students, that is those who have joined NIE in the previous year and were in their final year of the two-year Dip Ed Programme. The PGDE sample used were the students in the first semester of the one-year PGDE Programme.

### *The Pilot Study*

Before the main study, the SPQ was piloted to 140 PGDE students and 62 Dip Ed students. An additional form was attached to the SPQ for the students to make comments about the items of the SPQ. The objective was to check the reliability estimates of the sub-scales of the SPQ as well as check for the suitability of the items in terms of its wording, the language used or other ambiguities that students may encounter when responding to the items. Table 2 below shows the reliability estimates in terms of coefficient alpha for the pilot samples.

Table 2: Reliability Estimates of Sub-scales of SPQ (Alpha Coefficients) – Pilot Samples

	N	SM	SS	DM	DS	AM	AS
PGDE	140	.58	.74	.76	.63	.81	.74
Dip Ed	62	.69	.75	.83	.63	.72	.77

Note: SM=Surface Motive, SS=Surface Strategy, DM=Deep Motive, DS=Deep Strategy, AM=Achieving Motive, AS=Achieving Strategy.

It can be seen from Table 2 that the reliability estimates were generally high with the sub-scales surface motive and deep strategy being comparatively lower for both the samples.

The students reported that they enjoyed completing the questionnaire, the language used was suitable to them and they encountered no difficulties in understanding or responding to all the items in the SPQ. They took about 20 minutes to complete the task. Table 3 shows the reliability estimates of the sub-scales of the SPQ from studies overseas.

Table 3: Reliability Estimates of Sub-scales of SPQ (Alpha Coefficients) -- Overseas Studies

	N	SM	SS	DM	DS	AM	AS
All	2338	.53	.65	.60	.75	.74	.69
Hong Kong							
Australian	823	.61	.66	.65	.75	.72	.77
Unis.							

Note: SM=Surface Motive, SS=Surface Strategy, DM=Deep Motive, DS=Deep Strategy, AM=Achieving Motive, AS=Achieving Strategy.

The results from the pilot study were very encouraging. Comparing the reliability estimates of the sub-scales, it can be seen that although sample sizes were considerably smaller than those in the overseas studies, the reliability estimates were generally comparable and in many cases higher than those obtained overseas.

Data from the 140 PGDE students were subjected to factor analysis to check on the factor structure of the SPQ. The six-factor, varimax rotated, factor structure was not well-defined. However, a four-factor, varimax rotated, factor structure seemed to provide a more parsimonious solution to the factor structure of the SPQ. Table 4 shows the rotated component matrix of the factor structure of the SPQ.

Table 4: Rotated Component Matrix – PGDE (N=140)

Item	Component			
	F1	F2	F3	F4
I1		.310		
I7		.606		
I13		.518		
I19		.671		
I25		.143		
I31		.550		
I37		.593		
I4		.272		
I10		.391		
I16		.234		
I22		.371		
I28		.471		
I34		.348		
I40		.555		
I2	.513			
I8	.402			
I14	.565			
I20	.582			
I26	.584			
I32	.587			
I38	.251			
I5	.601			
I11	.671			
I17	.646			
I23	.794			
I29	.629			
I35	.399			
I41	.760			
I3				.449
I9				.140
I15				.649
I21				.614
I27				.359
I33				.656
I39				.237
I6			.336	
I12			.639	
I18			.571	
I24			.641	
I30			.353	
I36			.683	
I42			.519	

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Rotation converged in 16 iterations.

It can be seen in Table 4 that the four-factor solution seemed to be a reasonably good fit to the data. Loadings for each of the four factors were substantial except for items 4, 9, 16, 25 and 38. The loadings seemed to line themselves according to the sub-scales of the SPQ. Balla, Stokes & Stafford (1991) also came to the same conclusion that the four-factor model was the more parsimonious solution for the factor structure of the SPQ. Biggs (1987) and others had argued that the motive and strategy elements were closely linked. Taken in this way, there is justification to regard three distinct approaches and six different motive and strategy dimensions, with the achieving motive-strategy dimensions more distinguishable than the other two combinations. The sample size for the Dip Ed was relatively small, it was not factor analysed.

### Study 1: Results and Discussion

The final form of the SPQ was administered to 378 PGDE students and 269 Dip Ed students. These were the PGDE students who were attending the one-year pre-service PGDE

programme and the Dip Ed second year students who were attending the pre-service 2-year Dip Ed programme. Background data like age, sex, race, stream (Science or Arts) and some socio-economic status information were also collected from the respondents for this study which is part of the longitudinal study.

The reliability estimates in terms of coefficient alpha for the samples of the study were shown in Table 5 below.

Table 5: Reliability Estimates of Sub-scales of SPQ (Alpha Coefficients) – PGDE and Dip Ed Students

	N	SM	SS	DM	DS	AM	AS
PGDE	378	.64	.60	.78	.69	.77	.72
Dip Ed	269	.60	.68	.74	.60	.79	.79

Note: SM=Surface Motive, SS=Surface Strategy, DM=Deep Motive, DS=Deep Strategy, AM=Achieving Motive, AS=Achieving Strategy.

Again, when compared to studies in Hong Kong and Australia (Table 2), the reliability estimates were reasonably high and generally higher than the overseas cases.

Data from these two groups of students were subjected to factor analysis to determine the factor structure of the SPQ. Again, in both the samples the six-factor, varimax rotated, factor structure were not well-defined. In both cases, the four-factor, varimax rotated, factor structure seemed to provide more parsimonious solutions to the factor structure of the SPQ. Tables 6 and 7 show the rotated component matrix of the factor structure of the SPQ. For the PGDE sample, loadings on items 1, 7, 13, 19 and 35 were comparatively low. For the Dip Ed sample, loadings on items 1, 16, 22, 39 were relatively low and again item 35 had the lowest loading here.

Data from the PGDE and the Dip Ed samples were subjected to confirmatory factor analyses specifying a priori a six-factor model followed by a four-factor model. Both the six and four factor models were identified. The PGDE six-factor model resulted in a chi-square value of 1627.84 with 804 degrees of freedom; the four-factor model resulted in a chi-square value of 1702.83 with 813 degrees of freedom. For the Dip Ed sample corresponding figures were 1499.21 with 804 degrees of freedom and 1567.79 with 813 degrees of freedom. The other goodness of fit statistics were shown in Tables 8 and 9.

It can be seen from the confirmatory factor analyses that in both the cases, the six-factor as well as the four-factor models produced almost similar results. These analyses lend support to consider the six dimensions of the SPQ. Indeed the four-factor models again proved to be more parsimonious solutions, having comparatively similar goodness of fit statistics as the six factor models.

Summary statistics in terms of means and standard deviations of the SPQ sub-scales and also the surface, deep and achieving approaches are shown in Tables 10, 11 and 12. In both the PGDE and the Dip Ed samples, the deep approach had the highest mean followed by surface approach and then the achieving approach. Similarly, the trend was the same in the case of the Hong Kong universities' sample. Of particular interest in all the cases, the PGDE and Dip Ed samples have higher means for all the three approaches. In particular, the means for the deep approach were the highest for the PGDE sample, with the Dip Ed sample also higher than the Hong Kong study.

Table 6: Rotated Component Matrix – PGDE (N=378)

Item	Component			
	F1	F2	F3	F4
I1			.189	
I7			.289	
I13			.186	
I19			.279	
I25			.405	
I31			.437	
I37			.447	
I4			.573	
I10			.528	
I16			.534	
I22			.559	
I28			.461	
I34			.593	
I40			.594	
I2	.441			
I8	.497			
I14	.392			
I20	.418			
I26	.590			
I32	.553			
I38	.310			
I5	.542			
I11	.569			
I17	.422			
I23	.633			
I29	.448			
I35	.284			
I41	.675			
I3				.700
I9				.558
I15				.604
I21				.509
I27				.539
I33				.684
I39				.374
I6		.391		
I12		.602		
I18		.648		
I24		.595		
I30		.629		
I36		.617		
I42		.437		

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Rotation converged in 8 iterations.

Table 7: Rotated Component Matrix – Dip Ed (N=269)

Item	Component			
	F1	F2	F3	F4
I1			.150	
I7			.579	
I13			.442	
I19			.620	
I25			.548	
I31			.414	
I37			.437	
I4			.368	
I10			.371	
I16			.267	
I22			.248	
I28			.549	
I34			.503	
I40			.533	
I2		.502		
I8		.528		
I14		.621		
I20		.354		
I26		.565		
I32		.364		
I38		.492		
I5		.387		
I11		.577		
I17		.431		
I23		.359		
I29		.306		
I35		7.028E-02		
I41		.551		
I3			.623	
I9			.497	
I15			.671	
I21			.551	
I27			.597	
I33			.611	
I39			.125	
I6	.478			
I12	.699			
I18	.618			
I24	.691			
I30	.662			
I36	.602			
I42	.500			

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Rotation converged in 10 iterations.



Table 8: Goodness of Fit Statistics – PGDE (N=378)

	GFI	AGFI	RMR	PGFI
6-Factor Model	.82	.80	.069	.73
4-Factor Model	.81	.79	.071	.73

GFI=Goodness of Fit Index, AGFI=Adjusted Goodness of Fit Index,  
RMR=Root Mean Square Residual, PGFI=Parsimony Goodness of Fit Index.

Table 9: Goodness of Fit Statistics – Dip Ed (N=269)

	GFI	AGFI	RMR	PGFI
6-Factor Model	.78	.75	.078	.69
4-Factor Model	.77	.74	.081	.69

GFI=Goodness of Fit Index, AGFI=Adjusted Goodness of Fit Index,  
RMR=Root Mean Square Residual, PGFI=Parsimony Goodness of Fit Index.

Table 10: Means and Standard Deviations of Sub-scales of SPQ – Hong Kong University (N=473)

	Mean	Std. Deviation
SM	20.45	4.57
SS	19.57	4.16
SA	40.06	7.67
DM	22.59	4.74
DS	22.06	4.65
DA	44.64	8.42
AM	22.60	4.94
AS	20.48	4.86
AA	39.79	8.02

SM=Surface Motive, SS=Surface Strategy, SA=Surface Approach,  
DM=Deep Motive, DS=Deep Strategy, DA=Deep Approach,  
AM=Achieving Motive, AS=Achieving Strategy, AA=Achieving Approach  
Source: Biggs, J. (1992). Why and how do Hong Kong Students Learn? p.108

Table 11: Means and Standard Deviations of Sub-scales of SPQ – PGDE (N=378)

	Mean	Std. Deviation
SM	21.26	4.82
SS	20.20	4.42
SA	41.46	8.02
DM	24.51	4.31
DS	22.77	4.52
DA	47.28	7.84
AM	19.86	5.34
AS	21.16	4.91
AA	41.03	8.67

SM=Surface Motive, SS=Surface Strategy, SA=Surface Approach,  
DM=Deep Motive, DS=Deep Strategy, DA=Deep Approach,  
AM=Achieving Motive, AS=Achieving Strategy, AA=Achieving Approach

Table 12: Means and Standard Deviations of Sub-scales of SPQ – Dip Ed (N=269)

	Mean	Std. Deviation
SM	23.09	4.91
SS	21.63	4.17
SA	44.72	7.99
DM	24.00	4.73
DS	22.52	4.76
DA	46.53	8.55
AM	20.75	5.28
AS	22.05	5.22
AA	42.80	8.94

SM=Surface Motive, SS=Surface Strategy, SA=Surface Approach,  
DM=Deep Motive, DS=Deep Strategy, DA=Deep Approach,  
AM=Achieving Motive, AS=Achieving Strategy, AA=Achieving Approach

To explore further the pattern of distribution of the three approaches, Figures 1, 2, 3, 4, 5, and 6 show the histograms for the three approaches for both the samples.

PGDE students who adopt the surface approach were very well spread out about the mean, with more students scoring in the lower end than in the upper end of the scale. In contrast, although also well spread out about the mean for the deep approach, there were more students scoring in the upper end than in the lower end of the deep approach scale (Figure 2). For the achieving approach there were again less students scoring at the upper end of the scale.

Dip Ed students who preferred the surface approach were very well spread out about the mean, with slightly more students scoring in the lower end than in the upper end of the scale. In contrast, although also well spread out about the mean for the deep approach, there were more students scoring in the upper end than in the lower end of the deep approach scale (Figure 5). For the achieving approach, there were slightly more students scoring in the upper end of the scale

## Conclusion

The pilot study showed that the SPQ is a good questionnaire that students like to complete without much difficulty but with confidence and understanding. The SPQ was shown to possess some very good psychometric properties. The reliability estimates for all the six sub-scales of the SPQ in the pilot study as well as the main study for the PGDE and Dip Ed samples were high and comparable to corresponding figures obtained from the overseas studies in Australia and Hong Kong.

The factor structure and dimensionality of the SPQ were examined using exploratory as well as confirmatory factor analysis procedures. The findings here were consistent with those from overseas studies. Both the six-factor and the four-factor models were identified but the four-factor model seemed to provide a more parsimonious solution. Balla, Stokes and Stafford (1991) also found the four-factor structure to be the more parsimonious model. Over here, with the exception of only a few items, the rest lined themselves neatly on the four factors with the surface and deep motive and strategy items coming together. This could be due to the fact that the motive and strategy elements were closely linked (Biggs, 1987). Hence, although it was still credible to compare results over the six dimensions because of the research base that had been established over the years, comparing results over the three dimensions of surface, deep and achieving approaches would be more meaningful.

In both the PGDE and the Dip Ed samples in the National Institute of Education, students were found to be more involved in deep approaches rather than the surface approaches, although the achieving approaches also play a big role in their learning and studying behaviour. Contrary to popular beliefs that Asian students are good for reproducing and regurgitating material learned, the current study and the Hong Kong studies showed that the students here do involve themselves more in deep learning. At the National Institute of Education, the programmes encourage interactive teaching methods emphasising active participation of learners in the instructional process. The assessment of student performance has evolved from total dependence on one final examination to

Figure 1: Histogram of Surface Approach – PGDE (N=378)

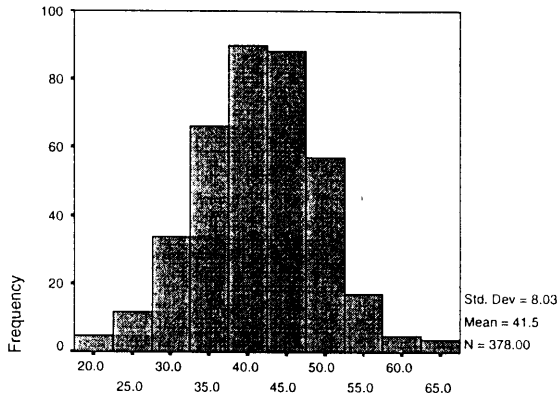


Figure 2: Histogram for Deep Approach – PGDE (N=378)

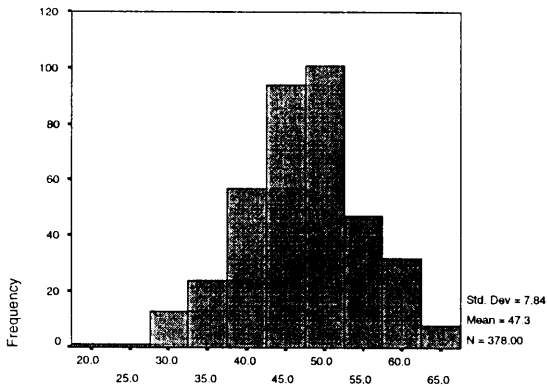


Figure 3: Histogram for Achieving Approach -- PGDE (N=378)

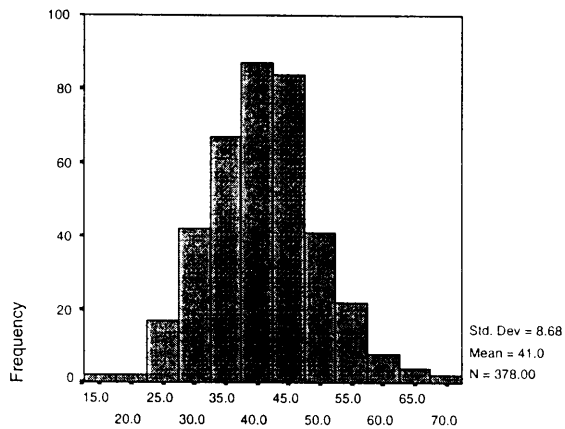


Figure 4: Histogram of Surface Approach – Dip Ed (269)

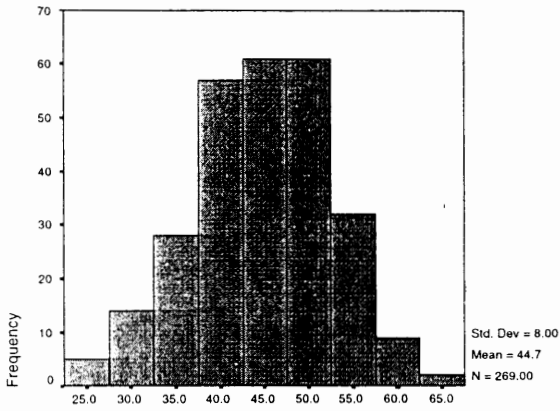


Figure 5: Histogram of Deep Approach – Dip Ed (269)

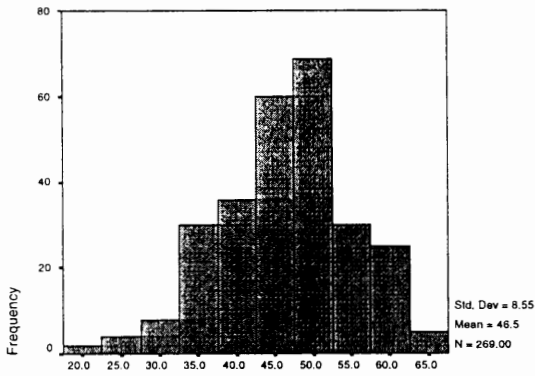
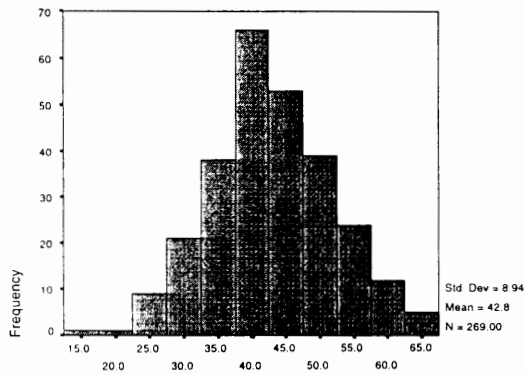


Figure 6: Histogram of Achieving Approach – Dip Ed (N=269)



incorporate various alternative procedures in continual assessment. These have in one way or the other, contributed to promote deep learning among the students.

This study is part of a longitudinal study that will further look into the factors that affect the studying and learning approaches with the view of promoting deep learning and thinking.

## Study 2: The Case of the NTU Engineering Students

The sample for this Study 2 consists of the first year engineering students enrolled in the Nanyang Technological University, Yunnan Campus, Singapore. Students in this programme are those who graduated from the schools after obtaining their GCE 'A' Level qualification. They are normally higher performing students in terms of results and qualify for degree courses in the universities. These students are in their first semester of the first year pursuing an engineering degree. As it is the policy of the university, these students in the first year do general engineering without being placed in any engineering specialisation like; civil, mechanical or electrical.

## Study 2: Results and Discussion

The SPQ was administered to 536 students in their first semester of the first year in engineering (ENGINE 1). The psychometric properties of the SPQ were again examined for this group of students. Table 13 shows the reliability estimates in terms of coefficient alpha for this sample.

The results here were comparable to the overseas results (Table 3), with the first three sub-scales in the .60s and the last three sub-scales in the .70s. Generally they were lower than those for the pilot samples (Table 2) and also the NIE samples (Table 5); but all the same these were reasonably high.

Data from this engineering sample was subjected to factor analyses to ascertain the factor structure as well as the dimensionality of the SPQ. Again, as before, the six-factor, varimax rotated, factor structure was not well-defined. Instead, the four-factor, varimax rotated, factor structure seemed to provide a more parsimonious and well-defined factor structure of the SPQ. Table 14 shows the rotated component matrix of the factor structure of the SPQ for this sample of students. With the exception of items 2, 16, 21, 27, 35, and 39; the rest of the items seemed to load themselves neatly and substantially on the dimension they belonged.

Data from this group of engineering students were subjected to confirmatory factor analyses, specifying a priori a six-factor model followed by a four-factor model. Here both the six and four factor models were identified. The ENGINE 1 six-factor model yielded a chi-square value of 2016.61 with 804 degrees of freedom while the four-factor model yielded a chi-square value of 2061.81 with 813 degrees of freedom. The other fit statistics were shown in Table 15 below.

Comparing the fit statistics with the PGDE and Dip Ed samples in Tables 8 and 9, it can be seen that the data were comparatively similar with the present case a little better than the previous two cases. Again here, it can be seen that the four-factor model proved to give a more parsimonious solution.

Summary statistics for the means and standard deviations of the SPQ sub-scales for this ENGINE 1 sample were shown in Table 16. Over here, the surface approach has the highest mean followed by the deep approach and the achieving approach.

Table 13: Reliability Estimates of Sub-scales of SPQ (Alpha Coefficients) – First Year Engineering Students

	N	SM	SS	DM	DS	AM	AS
ENGINE 1	536	.61	.58	.61	.71	.72	.71

Note: SM=Surface Motive, SS=Surface Strategy, DM=Deep Motive, DS=Deep Strategy, AM=Achieving Motive, AS=Achieving Strategy.

Table 14: Rotated Component Matrix – Engine 1 (N=536)

Item	Component			
	F1	F2	F3	F4
11		.372		
17		.390		
113		.427		
119		.556		
125		.396		
131		.406		
137		.533		
14		.482		
110		.448		
116		.241		
122		.513		
128		.406		
134		.440		
140		.602		
12	.265			
18	.348			
114	.548			
120	.205			
126	.630			
132	.477			
138	.308			
15	.498			
111	.460			
117	.484			
123	.634			
129	.438			
135	.293			
141	.642			
13			.706	
19			.733	
115			.622	
121			.253	
127			.168	
133			.465	
139			7.748E-02	
16		.452		
112		.504		
118		.601		
124		.603		
130		.376		
136		.622		
142		.345		

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Rotation converged in 7 iterations.

Table 15: Goodness of Fit Statistics – Engine 1 (N=536)

	GFI	AGFI	RMR	PGFI
6-Factor Model	.82	.80	.068	.73
4-Factor Model	.82	.80	.070	.74

GFI=Goodness of Fit Index, AGFI=Adjusted Goodness of Fit Index,  
RMR=Root Mean Square Residual, PGFI=Parsimony Goodness of Fit Index.

Table 16: Means and Standard Deviations of Sub-scales of SPQ – ENGINE 1 (N=536)

	Mean	Std. Deviation
SM	24.32	4.59
SS	23.58	4.07
SA	47.90	7.59
DM	23.44	4.33
DS	22.12	4.40
DA	45.55	7.88
AM	23.39	5.13
AS	20.82	4.94
AA	44.22	8.52

SM=Surface Motive, SS=Surface Strategy, SA=Surface Approach,  
DM=Deep Motive, DS=Deep Strategy, DA=Deep Approach,  
AM=Achieving Motive, AS=Achieving Strategy, AA=Achieving Approach

Compared to the figures for the Hong Kong study, means for all the three categories were higher, with surface approach highest. Compared to the PGDE figures, the ENGINE 1 group was higher in the surface approach and the achieving approach but lower in the deep approach. Similar pattern occurred when compared to the Dip Ed case.

To delve further into the figures, the pattern of distribution of the three approaches were shown in Figures 7, 8 and 9.

It can be seen in Figure 7 that ENGINE 1 students who preferred the surface approach were well spread out about the mean, with slightly more students scoring in the upper end of the surface approach scale. The distribution on the deep approach scale was also well spread out about the mean, but there were more students scoring in the upper end of the deep approach scale (Figure 8). For the achieving approach, the distribution was well-behaved with students' scores spreading about evenly about the mean over the achieving scale.

## Conclusion

This Study 2 involving 536 first year engineering students also showed that the SPQ is a good questionnaire that they have no difficulties in answering all the questions. The SPQ was once again shown to possess good psychometric properties. Reliability estimates of all the six sub-scales were comparable to the figures obtained overseas as well as the figures from the NIE samples.

The factor structure and the dimensionality of the SPQ were again investigated using the exploratory as well as the confirmatory factor analytic procedures. Both the six-factor and the four-factor models were identified, with the four-factor model giving a set of more parsimonious results. Again with the exception of a few items, the rest of the items were well-behaved, loading on the factors that they belonged. As with the results from Balla, Stokes and Stafford (1991), the four-factor solution looked very promising. Perhaps the Singapore and Hong Kong factor structure and dimensionality of the SPQ are similar but may be a little different from the Australian findings.

Students in the first year engineering programme in the Nanyang Technological University (NTU) were found to be more involved in surface approach rather than the deep approach or the achieving approach. Compared to the Hong Kong figures and the NIE figures, they seemed to score higher in the surface scale. But contrary to popular beliefs, they also involved themselves in deep and achieving approaches to no less an extent. This is the first year that NTU is trying to place more emphasis on continual assessments and because of the large numbers of students in the first year, teaching has been mainly lecture style. Hopefully, as years progress, and instructional and assessment procedures change, more students will be adopting the deep approach to studying and learning.

Figure 7: Histogram of Surface Approach – ENGINE 1 (N=536)

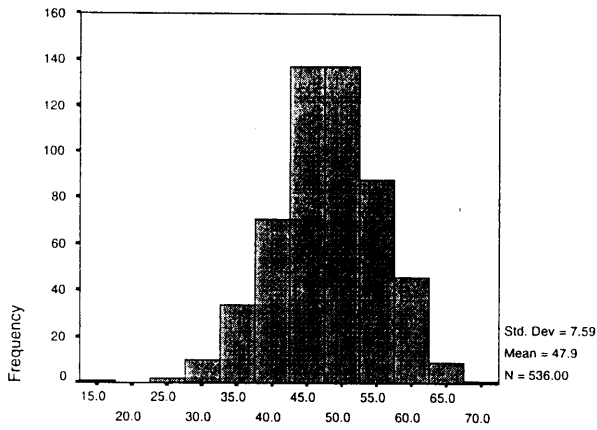


Figure 8: Histogram of Deep Approach – ENGINE 1 (N=536)

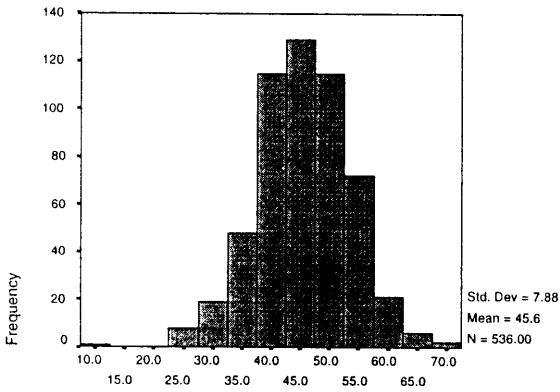
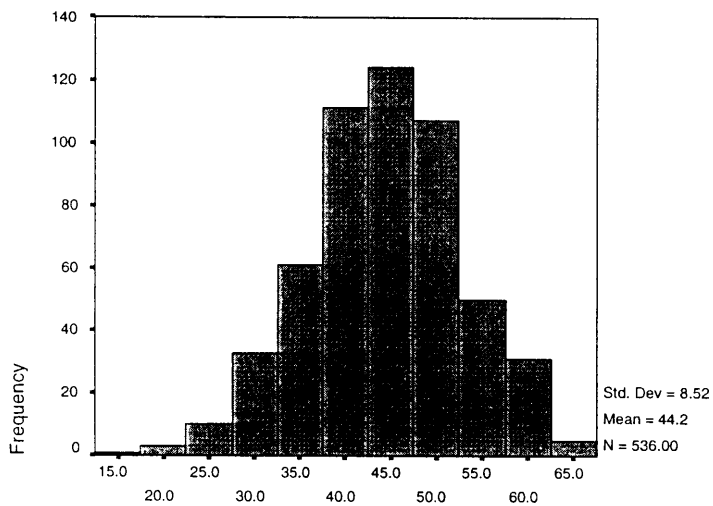


Figure 9: Histogram of Achieving Approach – ENGINE 1 (N=536)





This Study 2 is also part of the longitudinal study to look into the studying and learning approach of tertiary students in Singapore with the long term objective of promoting deep learning and thinking.

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