

Reliability of the Irish Survey of Student Engagement – 2016

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Conclusion

This document contains the results from an analysis of data taken from the Irish Survey of Student Engagement (ISSE) administered in 2016. It shows that, in general, the nine proposed indices are reliable, items are reasonably correlated within indices and there is evidence of known group validity. The proposed structure also provides a reasonably good fit to the data.

1. Introduction and Background

Surveys of student engagement in third level education have been undertaken for many years. In the US the National Survey of Student Engagement (NSSE) was launched in 2000. Both the Australasian Survey of Student Engagement (AUSSE) and Irish Survey of Student Engagement (ISSE) are based on the American survey (NSSE). The main aim of the surveys was to explore the opinion of undergraduates on their educational experience at third level institutions. The fundamental outcomes from this research was that student engagement with college life was associated with high level learning, persistence, academic, leadership, moral development, academic performance and critical thinking.

The ISSE is predominantly based on items from the NSSE and is informed by developments undertaken in Australia with the development of the AUSSE. The ISSE focuses on the teaching and learning activities and the extent to which students interact with these activities. The fundamental thesis underlying the measure of student engagement is:

When students read more, write more, and interact more in positive ways with their teachers and peers, they gain more in terms of essential skills and competencies, such as critical thinking, problem solving, effective communication, and responsible citizenship (NSSE 2000: 2).

The results from the ISSE can be used by institutions to improve the quality of the experience of undergraduate and postgraduate students in the higher education sector in Ireland.

The ISSE was designed to collect results from students at two points of time in their educational programme: at the end of first year and final year. The rationale for measuring these two points is that first year is recognised as a pivotal point in students engaging with their higher education; the final year is the point at which students can look back and evaluate their overall experience of higher education (NSSE 2000). In addition, the ISSE measured the institutional experience of taught postgraduate students; this built on the work done in

the Australasian higher education sector with the development of the Postgraduate Survey of Student Engagement (POSSE).

ISSE is managed in Ireland as a collaborative partnership and co-sponsored by the Higher Education Authority (HEA), institutions’ representative bodies (Institutes of Technology Ireland, IOTI, and the Irish Universities Association, IUA) and the Union of Students in Ireland (USI).

The ISSE was first undertaken in 2013 and replicated in 2014 and 2015. In 2016, a number of changes were made whereby the content of the questionnaire was revised and shortened. This report contains the results from detailed analysis of the data gathered in 2016. The analysis included an assessment of the reliability of the nine engagement indices used; Collaborative Learning, Reflective and Integrative Learning, Student-Faculty Interaction, Quantitative Reasoning, Learning Strategies, Higher-Order Learning, Effective Teaching Practices, Quality of Interactions, and Supportive Environment. A confirmatory factor analysis was also employed to assess the proposed 9 factor structure.

The nine engagement indices in ISSE are derived from 43 individual items. The objective is to evaluate the underlying structure of these indices and report on the reliability of the ISSE tool.

The questionnaire was administered to 29,173 students from 1st year (14,076), final year (10,650) and postgraduate students (4,447). These students came from Institutes of technology (12,942), Universities (12,932) and Other Institutions (3,299). Figure 1 presents the 9 indices (and index abbreviation) together with the response categories for each item within each index.

Figure 1: List of indices with response categories

CODE	ENGAGEMENT INDICES	RESPONSE CATEGORIES
CI	Collaborative Learning	Never, Sometimes, Often and Very Often
RI	Reflective and Integrative Learning	Never, Sometimes, Often and Very Often
SF	Student-Faculty Interaction	Never, Sometimes, Often and Very Often
QR	Quantitative Reasoning	Never, Sometimes, Often and Very Often
LS	Learning Strategies	Never, Sometimes, Often and Very Often
HO	Higher-Order Learning	Very little, Some, Quite a bit and Very much
ET	Effective Teaching Practices	Very little, Some, Quite a bit and Very much
QI	Quality of Interactions	7 point scale 1 (Poor) to 7 (Excellent), Not Applicable
SE	Supportive Environment	Very little, Some, Quite a bit and Very much

Some outputs in this report refer to the index code instead of the full index description.

1.2 Observations

The following observations are made:

- With one exception (QI – Quality of Interactions) 4-point scales were used. Using these scales it is important to note that the meaning and interpretation of the response categories may vary from person to person. Dillman¹(2000, p.55) advocates against the use of what's termed *vague quantifiers*. For example, one person's "sometimes" may be another person's "Often". The assumptions underlying many of the analyses are that these are interval scales, i.e. the distance from "Never" and "Sometimes" is the same as "Often" and "Very Often".
- A seven-point scale is used for the QI (or Quality of interaction) index with point 1 being labelled "Poor" and point 7 being labelled "Excellent". The interpretation of the meaning of the points within this range is left up to the respondents. There is an option for respondents to indicate that a particular item within this index is "not applicable". This has implications for the analysis as only responses from 1 to 7 are considered valid (See section two).
- All the scales used in the model are in the same direction from left to right with the left end indicating a negative response and the right end a positive response.
- The order of indices is constant, i.e. the items within each index are asked in the order shown in Figure 1. The items within each index were randomised during administration.
- The response data file contained a weight used to extrapolate to the population of students. This weight was not used (or required) during this analysis.
- Some outputs in this report are based on a transformed mean score instead of the original four-point or seven-point scale. This enables results across indices to be compared on a common scale.

¹ Mail and Internet Surveys 2nd Edition, New York: John Wiley, 2000 (new editions published since)

2. Analysis

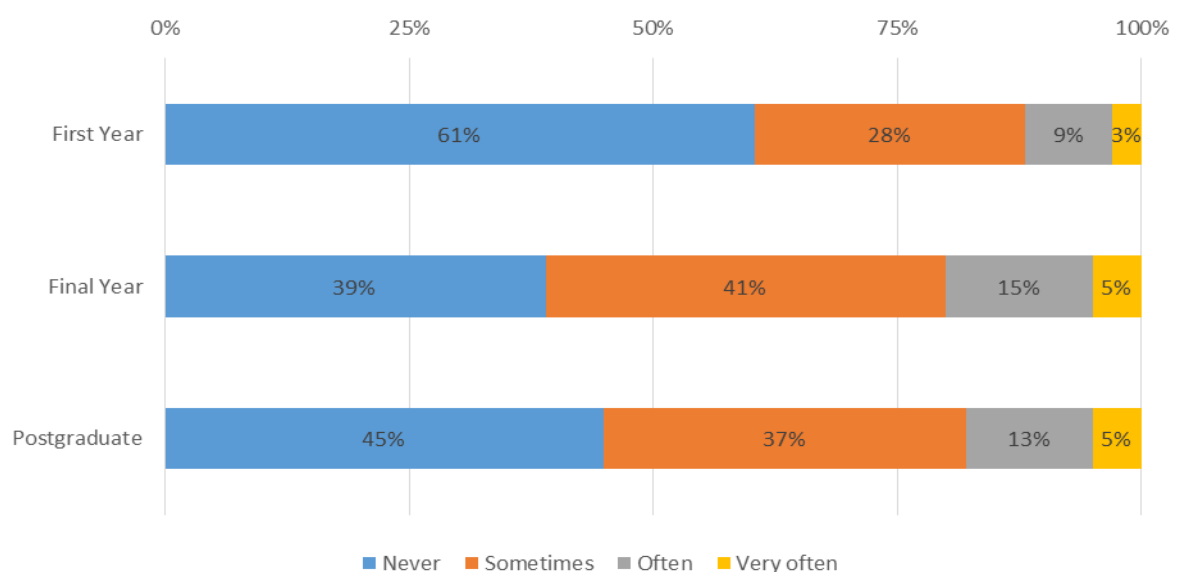
Appendix A presents the frequencies of each item contained within each index. It also shows the % of students who did not provide a valid response to the item (termed % missing in the table). As many of the analysis are based on correlations it is important to examine the frequency of each item. The percentage of missing data ranges from less than 1% to 21% with the percentage increasing from the beginning to the end of the questionnaire.

The item “Support services staff (career services, student activities, accommodation, etc.)” in the Quality of Interactions index was not answered by 21% of all students. Respondents to items within this index are allowed to respond “Not applicable” and this results in a larger than normal proportion of non-valid data (as they may not have had an interaction with support services). It is good coding practice to distinguish the missing data from “not applicable” responses so that the proportion of missing data can be compared across items.

The extent of missing data has implications for the reliability analysis and confirmatory factor analysis later in this report. Listwise deletion of cases is used and the total number of eligible cases for analysis is reduced because of the inclusion of this variable. Overall the responses are reasonably distributed across the response categories.

There were three study groups in the analysis: First Year, Final Year and Postgraduate. Each item was examined by this grouping variable to see if the three study groups responded differently. Some differences were found between the study groups providing evidence that the items are measuring what is expected, i.e. differences were expected. For example, Figure 2 and 3 show the differences between the three groups for two items.

Figure 2: Talked about career plans with academic staff by study group



From Figure 2, final year students (and postgraduate students) spoke more frequently about career plans with academic staff than first year students, i.e. 55% of postgraduate students and 61% of final year students talked about career plans with academic staff *at least sometimes* compared with 39% of first year students.

Figure 3: Identified key information from recommended reading materials by study group

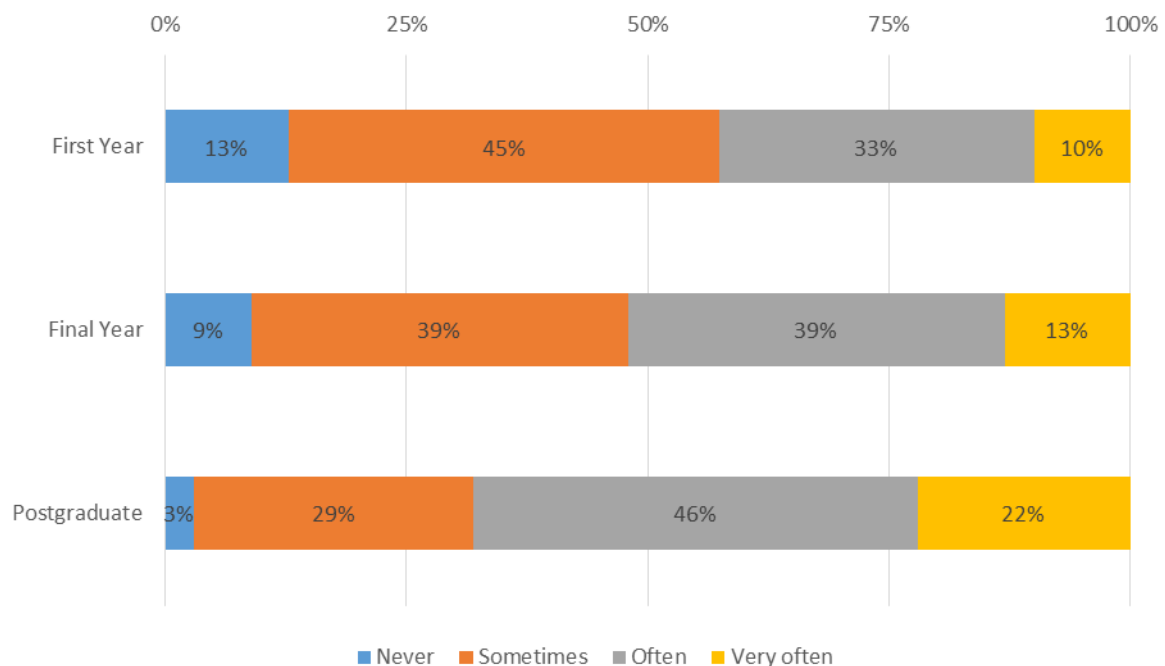


Figure 3 shows that the students in final and postgraduate years are more likely to identify key information from recommended reading materials, i.e. 68% of postgraduates and 52% of final year students indicated that they identified information from recommended reading materials by study group *often or very often* compared with 43% of first year students.

Figure 2 and Figure 3 are examples of known group validity within the data as the results conform to prior expectations.

Each of the 43 items are assigned to one of nine indices (as detailed in Appendix A). This section carries out a detailed analysis of the nine proposed indices by examining:

- Correlation among the 43 individual items
- Reliability of each of the nine indices
- Distribution of the total mean scores on each of the nine indices (and study groups)
- Correlation among the nine indices
- How well the proposed nine-factor structure fits the data

Each of these topics are covered in the coming pages.

2.1 Correlation (Items)

The correlations between all 43 items were computed at an overall level. See Appendix B for the overall correlation matrix. Colours were used to indicate the strength of the correlations with high values indicated by green and low values by red. Ideally items within an index should be highly correlated while items should not be correlated with items in other indices.

With the exception of the LS (Learning Strategy), items within each index are reasonably correlated with one another. Inspection of the item distributions for the LS scale (in Appendix A), shows that over 70% of responses fall into just 2 response categories. This *bunching* of responses into a narrow range of response categories may reduce the inter item correlation as the variability of the responses is reduced.

There are some examples of items being correlated with items from other indices, namely:

SE1 – Providing support to help students succeed academically

Is correlated with:

- ET1 *Clearly explained course goals and requirements*
- ET2 *Taught in an organised way*
- ET3 *Used examples or illustrations to explain difficult points*
- ET4 *Provided feedback on a draft or work in progress*
- ET5 *Provided prompt and detailed feedback on tests or completed assignments*
- Q12 *Academic advisors*
- Q13 *Academic staff*
- Q14 *Support services staff*
- Q15 *Other administrative staff and offices (registry, finance, etc.)*

Q12/Q13 - Interactions with academic advisors & staff

Are correlated with:

- ET1 *Clearly explained course goals and requirements*
- ET2 *Taught in an organised way*
- ET3 *Used examples or illustrations to explain difficult points*
- ET4 *Provided feedback on a draft or work in progress*
- ET5 *Provided prompt and detailed feedback on tests or completed assignments*

LS1 – Identified key information from recommended reading materials

Is correlated with:

- *RI1 Combined ideas from different subjects / modules when completing assignments*
- *RI2 Connected your learning to problems or issues in society*
- *RI6 Learned something that changed the way you understand an issue or concept?*
- *RI7 Connected ideas from your subjects / modules to your prior experiences and knowledge*
- *HO2 Analysing an idea, experience, or line of reasoning in depth by examining its parts*
- *HO3 Evaluating a point of view, decision, or information source*
- *HO4 Forming an understanding or new idea from various pieces of information*

Ideally items within an index should only correlate with other items within the same index. From above (and Appendix B) some items are also correlated with other items from different indices. Reading the text from the items listed above, it is not difficult to understand why some items are correlated with one another between indices.

2.2 Reliability (Indices)

The reliability of each index was assessed by calculating a Cronbach's Alpha, which is a measure of internal consistency of all items within an index, i.e. how well items *hang* together. Cronbach's Alpha was computed for the overall group for each index and also for each study group. The results are displayed in Figure 4.

Figure 4: Cronbach's Alpha for each index overall and by study group

Number of Items	Description	Overall	First Year	Final Year	Post graduate
4	Collaborative Learning	0.66	0.63	0.67	0.70
7	Reflective and Integrative Learning	0.77	0.74	0.78	0.79
4	Student-Faculty Interaction	0.76	0.74	0.76	0.74
3	Quantitative Reasoning	0.72	0.69	0.72	0.77
3	Learning Strategies	0.64	0.64	0.65	0.63
4	Higher-Order Learning	0.82	0.80	0.82	0.85
5	Effective Teaching Practices	0.81	0.79	0.83	0.85
5	Quality of Interactions	0.86	0.87	0.85	0.87
8	Supportive Environment	0.87	0.86	0.87	0.88

The value of Cronbach's Alpha was similar for each index across the groups. Although the Cronbach's Alpha values were generally high, the indices "Collaborative Learning" and

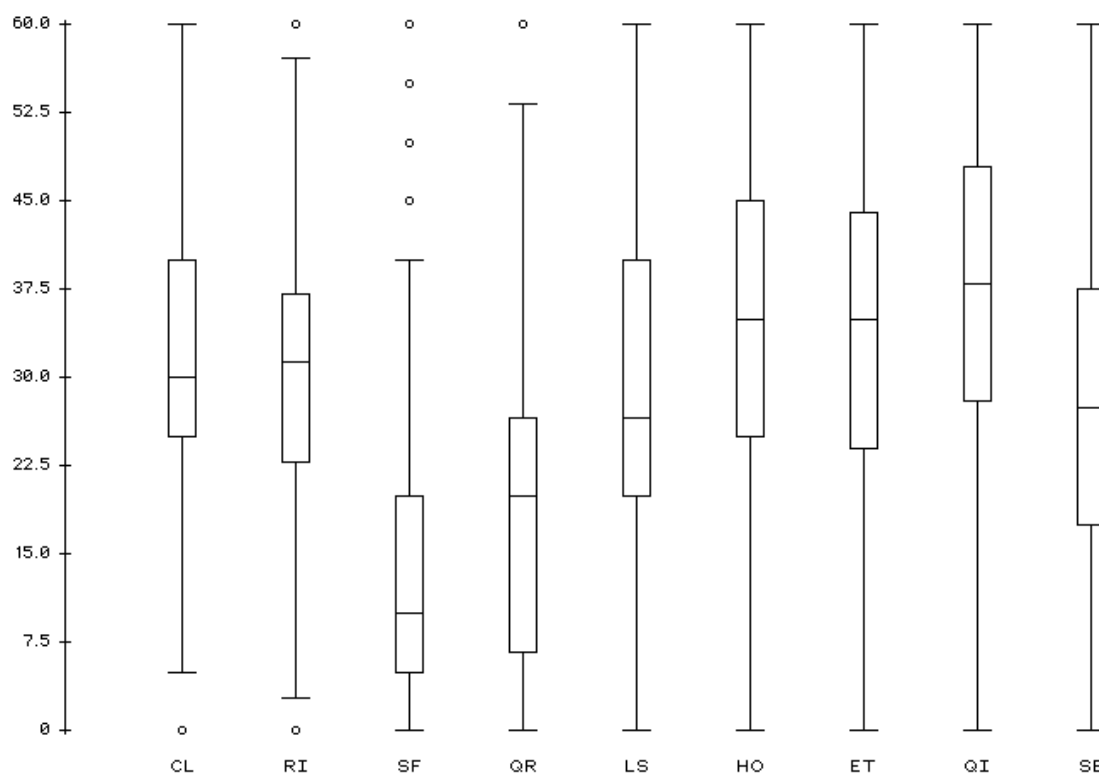
“Learning Strategies” were somewhat lower than the other indices (0.66 and 0.64 respectively). Cronbach’s Alpha is affected by the number of items and the strength of the inter-correlations between them. For the two scales Collaborative Learning and Learning Strategies the inter-item correlations were relatively low and the indices consisted of only 3 and 4 items respectively.

Appendix C provides further information on the reliability analysis for the overall group, in particular, it shows what happens to the Cronbach’s Alpha when an item is deleted. In the majority of cases the value for Cronbach’s Alpha decreases for each variable indicating that the item concerned is making a positive contribution to the index.

2.3 Mean Scores (Indices)

A transformed mean score was computed for each student for each of the nine indices. The responses were transformed to a common total enabling a comparison to be made between indices where four-point scales were used and indices where seven-point scales were used. Means were calculated for each student when an acceptable number of items were completed within each index. See Appendix D for a description how mean scores transformed. Figure 5 shows the distribution of the transformed mean score for each index.

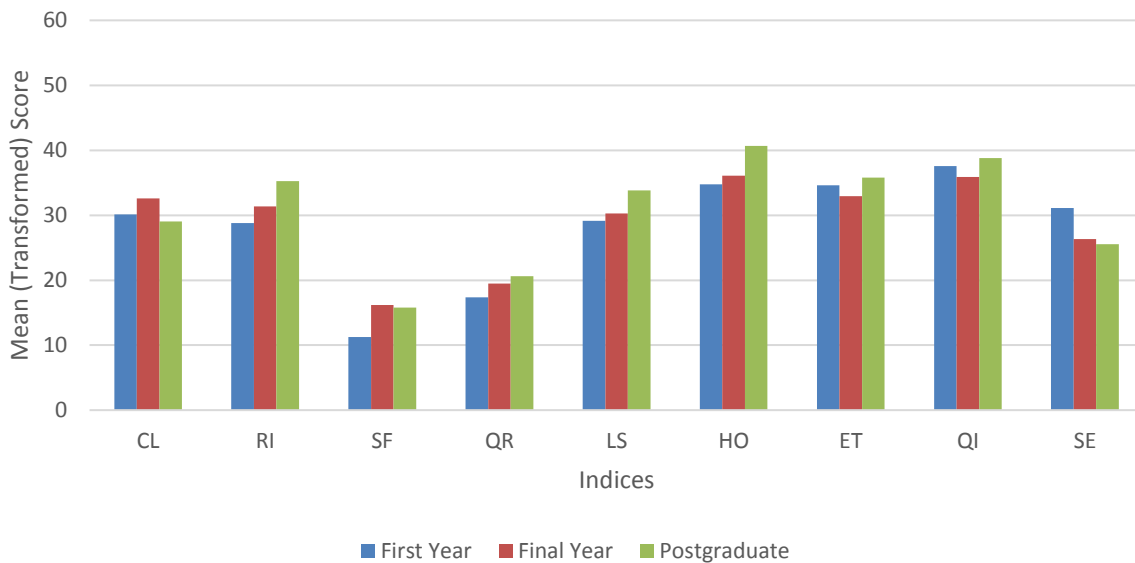
Figure 5: Distribution of the transformed mean scores for the 9 indices [range 0 to 60]



The means for the indices SF (Student Faculty Interaction) and QI (Quantitative Reasoning) are lower than the other seven indices. This is consistent with what was expected and with previous research on the topic.

Figure 6 presents the transformed means for each index by study group.

Figure 6: Mean (transformed) scores for each index by study group



From Figure 6, the mean scores for postgraduate students are noticeably higher than the first years and final years for the indices “Reflective and Integrated Learning”, “Higher Order Learning” and “Learning Strategies”. This is consistent with what was expected and contributes to known group validity.

2.4 Correlation (Indices)

Figure 7 presents the correlations among the 9 indices for the overall group. The correlation for each of study groups (First year, final year and postgraduate) are shown in Appendix E. Again these are coloured by size with green indicating higher positive correlations.

Figure 7: Correlation between the nine indices

	All	1	2	3	4	5	6	7	8
1	Collaborative Learning								
2	Reflective and Integrative Learning	0.30							
3	Student-Faculty Interaction	0.30	0.36						
4	Quantitative Reasoning	0.27	0.30	0.35					
5	Learning Strategies	0.20	0.46	0.33	0.31				
6	Higher-Order Learning	0.18	0.49	0.27	0.30	0.40			
7	Effective Teaching Practices	0.13	0.29	0.28	0.21	0.33	0.44		
8	Quality of Interactions	0.17	0.25	0.32	0.20	0.27	0.36	0.54	
9	Supportive Environment	0.18	0.24	0.24	0.21	0.25	0.35	0.47	0.52

Looking at Figure 7, the correlations are all positive and the correlation matrices for each study group (in Appendix E) are quite similar. Focusing on the correlations in the overall group the correlations range between 0.13 (ET & CL) and 0.54 (ET & QI). The highest correlations are between the indices “Effective Teaching Practices”, “Quality of Interactions” and “Supportive Environment”.

2.5 Confirmatory Factor Analysis

In this section, indices are referred to as factors. A confirmatory factor analysis was undertaken to assess the fit of the nine factors proposed. The aim of this analysis is to reproduce the correlation matrix between the original items by describing the correlation with a simpler underlying model. Only students with complete data across the 43 items were used, i.e. 18,592 students² (which represented approximately 64% of all the student responses).

A sequence of models were fitted to the data. The initial model consisted of the nine factors as described above allowing for correlation between factors with independent errors. The final model chosen was a model with the following attributes:

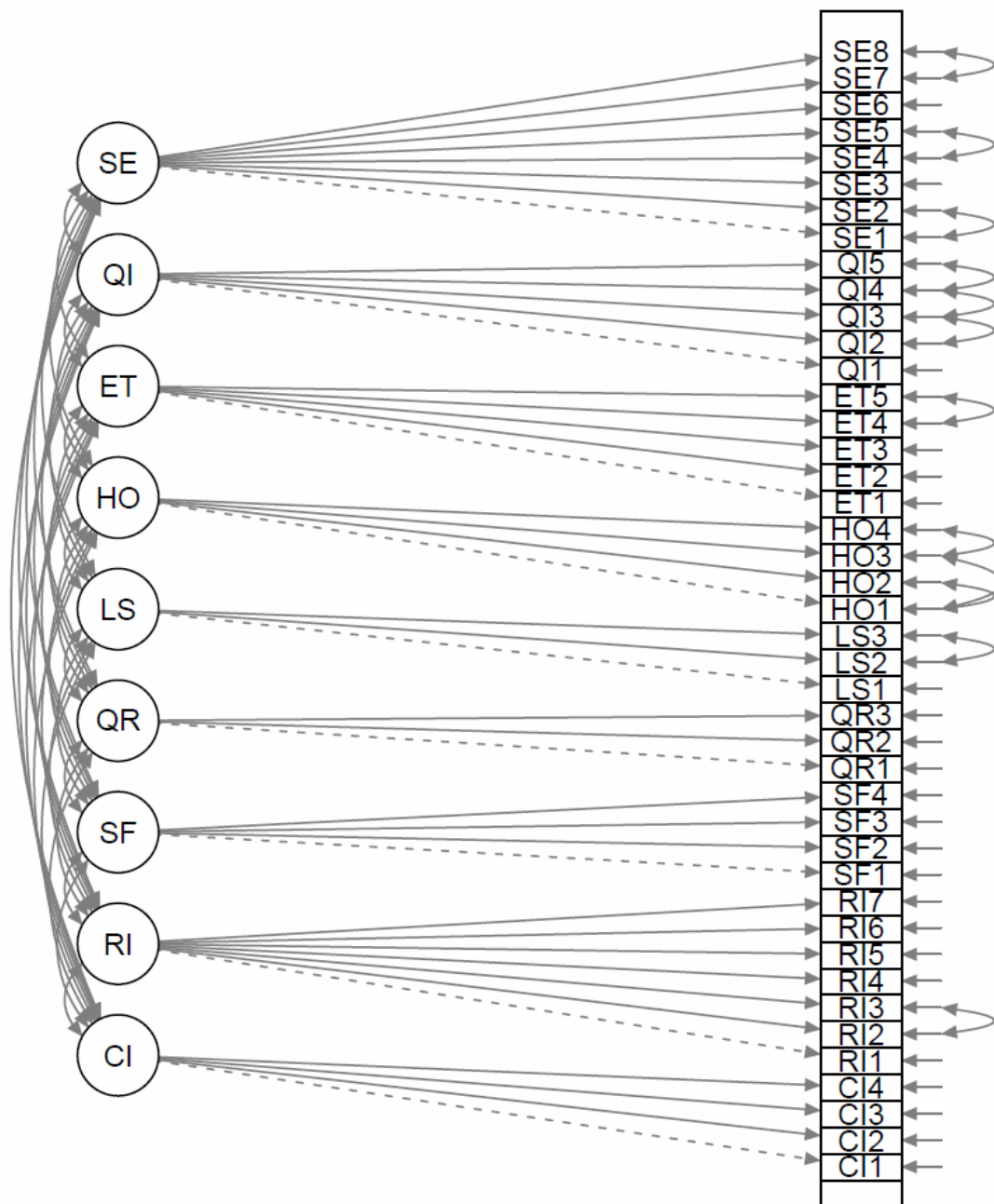
- Nine underlying factors corresponding with the nine factors described above,
- Correlations between factors were allowed (See Figure 7 for reason why),
- All errors were assumed to be independent with the following exceptions where items were allowed to be correlated with one another:
 - ET4 with ET5
 - QI4 with QI5
 - SE7 with SE8
 - QI2 with QI3
 - QI3 with QI4
 - LS2 with LS3
 - HO1 with HO2
 - HO3 with HO4
 - RI2 with RI3
 - HO1 with HO3
 - SE1 with SE2
 - SE4 with SE5

The inclusion of the above terms improved the initial model and suggested that the items listed above were correlated for reasons other than the shared influence of the underlying factor e.g. similar words in questions.

² Note that over 1,200 cases were removed as a direct result of including QI – Support services staff (career services, student activities, accommodation, etc.) because approximately 21% of respondents did not answer this question.

The final model chosen (with the above attributes) is illustrated in Figure 8.

Figure 8: Description of final model



The analysis was implemented using the R package lavaan³(Rosseel, 2012). The package lavaan was designed to implement structural equation modelling. Confirmatory Factor Analysis is a subset of this technique.

³ Rosseel, Y. lavaan: An R package for Structural Equation Modelling, Journal of the Statistical Software May 2012, Volume 48, Issue 2.

The final model, as described above, provided a reasonable fit to the data. Each of the paths in Figure 8 were necessary and allowing correlations between the factors was important (recall the inter-correlations shown in Figure 7). The simplest method of visualising the fit of the model is to reproduce the correlation matrix using the model and compare it to the original matrix. Figure 9 shows a summary of the differences between the correlations generated by the model and the original correlations.

Figure 9: Differences between original correlation matrix and generated correlation matrix

Difference between correlations	%
Less than (or equal to) -0.10	1
Between -0.05 and -0.09	12
Between -0.04 and 0.04	77
Between 0.05 and 0.09	8
Greater than (or equal to) 0.10	2
Total (N = 903)	100

From Figure 9, there are 903 inter-item correlations being compared. More than three-quarters (77%) of the differences are less than 0.04 which is considered a good fit.

A range of measures of fit were applied to the model with the following results:

1. **Standard Root Mean Square Residual (SRMR).** The SRMR is the square root of the average of sum of the squares of the correlations from Figure 9. It ranges in value from 0.0 to 1.0 with 0 indicating a perfect fit. For this example, it is 0.038 which is considered to be a reasonable fit.
2. **Root Mean Square Error of Approximation (RMSEA).** It is suggested that values below 0.05 indicate a reasonable fit. In this model a value of 0.036 was obtained. The 90% Confidence Interval is often quoted here and ranges from 0.036 to 0.037 (because of the large sample size this is very narrow).
3. **Comparative Fit Index (CFI).** This index compares the model to a baseline model of independence and a score of 0.94 was observed which indicates a reasonable fit.
4. **Tucker Lewis Index (TLI).** The index score was calculated as 0.93 another indication that the model was a good fit.

All of the above goodness of fit indices indicate that the final model, as described above, provides a good fit to the data.

Appendix A – Item Profiles [N = 29,173]

A total of 29,173 students participated in the survey and the distribution of valid responses to each item within each index is shown below. Not all students answered all items and the percentage of missing values is also provided. The proportion of missing values for items within “Collaborative Learning” and “Reflective and Integrative Learning” are relatively low, i.e. less than 1% of all respondents. The largest proportion of missing values were for “Quality of Interactions” where up to 21% of missing values were noted. This is primarily due to some items not being experienced (and a not applicable option being selected). It would be useful to be able to distinguish the missing data from the “not applicable” data for these items.

Collaborative Learning	Never	Some-times	Often	Very often	Total	% Missing
Asked another student to help you understand course material?	10%	48%	30%	12%	100%	0.50%
Explained course material to one or more students	6%	45%	35%	14%	100%	0.50%
Prepared for exams by discussing or working through course material with other students	16%	37%	30%	17%	100%	0.40%
Worked with other students on projects or assignments	11%	33%	33%	23%	100%	0.50%

Reflective and Integrative Learning	Never	Some-times	Often	Very often	Total	% Missing
Combined ideas from different subjects / modules when completing assignments	6%	37%	40%	17%	100%	0.50%
Connected your learning to problems or issues in society	18%	40%	29%	13%	100%	0.60%
Included diverse perspectives (political, religious, racial/ethnic, gender, etc.) in discussions or assignments	32%	38%	21%	9%	100%	0.50%
Examined the strengths and weaknesses of your own views on a topic or issue	11%	43%	35%	11%	100%	0.50%
Tried to better understand someone else's views by imagining how an issue looks from their perspective	8%	41%	37%	14%	100%	0.40%
Learned something that changed the way you understand an issue or concept?	4%	34%	45%	17%	100%	0.50%
Connected ideas from your subjects / modules to your prior experiences and knowledge	3%	31%	43%	23%	100%	0.60%

Student Faculty Interaction	Never	Some-times	Often	Very often	Total	% Missing
Talked about career plans with academic staff	50%	34%	12%	4%	100%	7%
Worked with academic staff on activities other than coursework (committees, student groups, etc.)	68%	22%	8%	2%	100%	7%
Discussed course topics, ideas, or concepts with academic staff outside of class	43%	38%	14%	5%	100%	7%
Discussed your performance with academic staff	38%	44%	14%	4%	100%	7%

Quantitative Reasoning	Never	Some-times	Often	Very often	Total	% Missing
Reached conclusions based on your analysis of numerical information (numbers, graphs, statistics, etc.)	29%	41%	22%	8%	100%	7%
Used numerical information to examine a real-world problem or issue (unemployment, climate change, public health, etc.)	39%	38%	17%	6%	100%	7%
Evaluated what others have concluded from numerical information	40%	42%	15%	3%	100%	7%

Learning Strategies	Never	Some-times	Often	Very often	Total	% Missing
Identified key information from recommended reading materials	10%	40%	37%	13%	100%	7%
Reviewed your notes after class	9%	44%	33%	14%	100%	7%
Summarised what you learned in class or from course materials	10%	44%	34%	12%	100%	7%

Higher order learning	Very little	Some	Quite a bit	Very much	Total	% Missing
Applying facts, theories, or methods to practical problems or new situations	7%	26%	42%	25%	100%	11%
Analysing an idea, experience, or line of reasoning in depth by examining its parts	8%	30%	39%	23%	100%	11%
Evaluating a point of view, decision, or information source	8%	30%	40%	22%	100%	11%
Forming an understanding or new idea from various pieces of information	6%	27%	42%	25%	100%	11%

Effective Teaching Strategies	Very little	Some	Quite a bit	Very much	Total	% Missing
Clearly explained course goals and requirements	6%	25%	43%	26%	100%	11%
Taught in an organised way	5%	27%	43%	25%	100%	11%
Used examples or illustrations to explain difficult points	4%	22%	42%	32%	100%	11%
Provided feedback on a draft or work in progress	22%	33%	28%	17%	100%	11%
Provided prompt and detailed feedback on tests or completed assignments	22%	34%	28%	16%	100%	11%

Supportive Environment	Very little	Some	Quite a bit	Very much	Total	% Missing
Providing support to help students succeed academically	10%	32%	38%	20%	100%	12%
Using learning support services (learning centre, computer centre, maths support, writing support etc.)	16%	29%	33%	22%	100%	12%
Contact among students from different backgrounds (social, racial/ethnic, religious, etc.)	26%	34%	27%	13%	100%	12%
Providing opportunities to be involved socially	15%	30%	34%	21%	100%	12%
Providing support for your overall well-being (recreation, health care, counselling, etc.)	14%	30%	34%	22%	100%	12%
Helping you manage your non-academic responsibilities (work, family, etc.)	41%	34%	18%	7%	100%	12%
Attending campus activities and events (special speakers, cultural performances, sporting events, etc.)	19%	34%	31%	16%	100%	12%
Attending events that address important social, economic, or political issues	27%	37%	25%	11%	100%	12%

Quality of Interactions	Poor	2	3	4	5	6	Excellent	Total	% Missing
Students	3%	2%	6%	14%	19%	18%	38%	100%	12%
Academic advisors	8%	8%	14%	20%	19%	14%	17%	100%	17%
Academic staff	5%	5%	12%	19%	21%	17%	21%	100%	12%
Support services staff (career services, student activities, accommodation, etc.)	9%	9%	13%	18%	18%	14%	19%	100%	21%
Other administrative staff and offices (registry, finance, etc.)	9%	10%	13%	19%	18%	14%	17%	100%	17%

Appendix C – Correlation and Reliability by Indices

Collaborative Learning (Cronbach's Alpha = 0.66)						
Inter-Item Correlation Matrix (listwise deletion)						
		1	2	3	4	*
1	Asked another student to help you understand course material?	1.00				0.59
2	Explained course material to one or more students	0.30	1.00			0.60
3	Prepared for exams by discussing or working through course material with other students	0.39	0.35	1.00		0.55
4	Worked with other students on projects or assignments	0.28	0.29	0.34	1.00	0.62

* Cronbach's Alpha if item deleted

Reflective and Integrative Learning (Cronbach's Alpha = 0.77)									
Inter-Item Correlation Matrix (listwise deletion)									
		1	2	3	4	5	6	7	*
1	Combined ideas from different subjects / modules when completing assignments	1.00							0.75
2	Connected your learning to problems or issues in society	0.32	1.00						0.73
3	Included diverse perspectives (political, religious, racial/ethnic, gender, etc.) in discussions or assignments	0.28	0.43	1.00					0.75
4	Examined the strengths and weaknesses of your own views on a topic or issue	0.31	0.33	0.31	1.00				0.74
5	Tried to better understand someone else's views by imagining how an issue looks from their perspective	0.28	0.34	0.33	0.38	1.00			0.75
6	Learned something that changed the way you understand an issue or concept?	0.32	0.33	0.25	0.32	0.29	1.00		0.75
7	Connected ideas from your subjects / modules to your prior experiences and knowledge	0.42	0.37	0.28	0.34	0.31	0.34	1.00	0.74

* Cronbach's Alpha if item deleted

Student-Faculty Interaction (Cronbach's Alpha = 0.76)						
Inter-Item Correlation Matrix (listwise deletion)						
		1	2	3	4	
1	Talked about career plans with academic staff	1.00				*
2	Worked with academic staff on activities other than coursework (committees, student groups, etc.)	0.41	1.00			0.69
3	Discussed course topics, ideas, or concepts with academic staff outside of class	0.46	0.42	1.00		0.73
4	Discussed your performance with academic staff	0.47	0.37	0.48	1.00	0.68
						0.69

* Cronbach's Alpha if item deleted

Quantitative Reasoning (Cronbach's Alpha = 0.72)					
Inter-Item Correlation Matrix (listwise deletion)					
		1	2	3	
1	Reached conclusions based on your analysis of numerical information (numbers, graphs, statistics, etc.)	1.00			*
2	Used numerical information to examine a real-world problem or issue (unemployment, climate change, public health, etc.)	0.45	1.00		0.60
3	Evaluated what others have concluded from numerical information	0.51	0.43	1.00	0.67
					0.62

* Cronbach's Alpha if item deleted

Learning Strategies (Cronbach's Alpha = 0.64)					
Inter-Item Correlation Matrix (listwise deletion)					
		1	2	3	
1	Identified key information from recommended reading materials	1.00			*
2	Reviewed your notes after class	0.33	1.00		0.61
3	Summarised what you learned in class or from course materials	0.36	0.44	1.00	0.53
					0.49

* Cronbach's Alpha if item deleted

Higher-Order Learning (Cronbach's Alpha = 0.82)						
Inter-Item Correlation Matrix (listwise deletion)						
		1	2	3	4	
1	Applying facts, theories, or methods to practical problems or new situations	1.00				*
2	Analysing an idea, experience, or line of reasoning in depth by examining its parts	0.55	1.00			0.82
3	Evaluating a point of view, decision, or information source	0.41	0.61	1.00		0.74
4	Forming an understanding or new idea from various pieces of information	0.44	0.57	0.63	1.00	0.76
						0.77

* Cronbach's Alpha if item deleted

Effective Teaching Practices (Cronbach's Alpha = 0.81)							
Inter-Item Correlation Matrix (listwise deletion)							
		1	2	3	4	5	*
1	Clearly explained course goals and requirements	1.00					0.78
2	Taught in an organised way	0.58	1.00				0.77
3	Used examples or illustrations to explain difficult points	0.50	0.57	1.00			0.78
4	Provided feedback on a draft or work in progress	0.39	0.39	0.40	1.00		0.78
5	Provided prompt and detailed feedback on tests or completed assignments	0.41	0.41	0.40	0.66	1.00	0.77

* Cronbach's Alpha if item deleted

Quality of Interactions (Cronbach's Alpha = 0.86)							
Inter-Item Correlation Matrix (listwise deletion)							
		1	2	3	4	5	*
1	Students	1.00					0.88
2	Academic advisors	0.47	1.00				0.81
3	Academic staff	0.47	0.77	1.00			0.81
4	Support services staff (career services, student activities, accommodation, etc.)	0.38	0.60	0.58	1.00		0.82
5	Other administrative staff and offices (registry, finance, etc.)	0.35	0.58	0.58	0.72	1.00	0.83

* Cronbach's Alpha if item deleted

Supportive Environment (Cronbach's Alpha = 0.87)										
Inter-Item Correlation Matrix (listwise deletion)										
		1	2	3	4	5	6	7	8	*
1	Providing support to help students succeed academically	1.00								0.86
2	Using learning support services (learning centre, computer centre, maths support, writing support etc.)	0.58	1.00							0.86
3	Contact among students from different backgrounds (social, racial/ethnic, religious, etc.)	0.42	0.41	1.00						0.87
4	Providing opportunities to be involved socially	0.43	0.43	0.48	1.00					0.85
5	Providing support for your overall well-being (recreation, health care, counselling, etc.)	0.47	0.47	0.43	0.65	1.00				0.85
6	Helping you manage your non-academic responsibilities (work, family)	0.40	0.36	0.43	0.46	0.53	1.00			0.86
7	Attending campus activities and events (special speakers, cultural performances, sporting events, etc.)	0.37	0.38	0.36	0.57	0.55	0.46	1.00		0.85
8	Attending events that address important social, economic, or political issues	0.36	0.36	0.40	0.51	0.51	0.48	0.68	1.00	0.86

* Cronbach's Alpha if item deleted

Appendix D – Transformation and Mean Score

Index	Description	Items	Minimum Items	Scale Categories
CL	Collaborative Learning	4	4	4
RI	Reflective and Integrative Learning	7	6	4
SF	Student-Faculty Interaction	4	4	4
QR	Quantitative Reasoning	3	3	4
LS	Learning Strategies	3	3	4
HO	Higher-Order Learning	4	4	4
ET	Effective Teaching Practices	5	4	4
QI	Quality of Interactions	5	4	7
SE	Supportive Environment	8	7	4

From the above table;

- CL is the abbreviation for Collaborative Learning. There are four items (or questions) within CL and all four items need to be answered by a particular student before an overall index score is calculated. All four items within CL have a 4-point scale.
- RI is the abbreviation for Reflective and Integrative Learning. There are seven items within RI and at least six items need to be answered by a particular student before an overall index score is calculated.
- The remaining seven indices are described in the same manner.

When comparing results from items with a four-point scale to items with a seven-point scale it is necessary to transform the data into a common scale.

Scale Point	Transformation Four-Point Scale	Transformation Seven-Point Scale
1	0	0
2	20	10
3	40	20
4	60	30
5		40
6		50
7		60

From the above, where a four-point scale is used each point is multiplied by the number in the second column. Where a seven-point scale is used each point is multiplied by the number in the third column.

Appendix E – Inter-Index Correlations by Study Groups

	First Year	1	2	3	4	5	6	7	8
1	Collaborative Learning								
2	Reflective and Integrative Learning	0.31							
3	Student-Faculty Interaction	0.28	0.30						
4	Quantitative Reasoning	0.26	0.28	0.31					
5	Learning Strategies	0.21	0.43	0.29	0.28				
6	Higher-Order Learning	0.21	0.46	0.22	0.28	0.36			
7	Effective Teaching Practices	0.18	0.30	0.26	0.18	0.31	0.42		
8	Quality of Interactions	0.20	0.26	0.31	0.17	0.26	0.33	0.50	
9	Supportive Environment	0.21	0.28	0.20	0.21	0.26	0.38	0.45	0.51

	Final Year	1	2	3	4	5	6	7	8
1	Collaborative Learning								
2	Reflective and Integrative Learning	0.32							
3	Student-Faculty Interaction	0.31	0.38						
4	Quantitative Reasoning	0.28	0.29	0.38					
5	Learning Strategies	0.20	0.46	0.36	0.33				
6	Higher-Order Learning	0.18	0.49	0.30	0.32	0.41			
7	Effective Teaching Practices	0.11	0.30	0.33	0.25	0.34	0.44		
8	Quality of Interactions	0.16	0.26	0.36	0.24	0.28	0.38	0.57	
9	Supportive Environment	0.18	0.29	0.33	0.25	0.29	0.38	0.50	0.56

	Postgraduate	1	2	3	4	5	6	7	8
1	Collaborative Learning								
2	Reflective and Integrative Learning	0.30							
3	Student-Faculty Interaction	0.33	0.36						
4	Quantitative Reasoning	0.29	0.30	0.36					
5	Learning Strategies	0.22	0.46	0.35	0.32				
6	Higher-Order Learning	0.16	0.50	0.27	0.27	0.42			
7	Effective Teaching Practices	0.09	0.29	0.31	0.22	0.34	0.48		
8	Quality of Interactions	0.15	0.24	0.36	0.21	0.28	0.38	0.57	
9	Supportive Environment	0.20	0.26	0.38	0.26	0.25	0.37	0.46	0.51