

1 Subscales in the National Student Survey (NSS): Some considerations on their structure

2 Thomas V. Pollet¹ & Lee Shepherd¹

3 ¹ Northumbria University

4 Author Note

5 Thomas Pollet, Lee Shepherd, Dept. of Psychology, Northumbria University, Newcastle
6 upon Tyne, UK. This paper is currently under review with a journal. **This version:**
7 **22/7/2021. Cite at own risk**

8 Correspondence concerning this article should be addressed to Thomas V. Pollet, NB
9 165, Northumberland Building, 2 Ellison Place, NE18ST, Newcastle Upon Tyne, UK..
10 E-mail: thomas.pollet@northumbria.ac.uk

Abstract

Measures of student satisfaction are commonly used to compare universities. Student satisfaction with higher education institutions in the UK is assessed yearly using the National Student Survey (NSS). The most recent revision of the NSS suggests that the satisfaction questions form eight different subscales. The aim of this research was to empirically test whether the NSS questions form eight separate subscales. We used the public data from the NSS from 2019 and clustering methods to examine the structure of the data. We tested the structure of the NSS questions when the data was analysed as a whole (i.e., at the ‘top’ national level across all universities and courses). We also assessed the clustering of data for 78 course subjects separately to see the most frequent number of clusters across courses (i.e., at the ‘bottom’ individual course level). At the top (national) level, we found a four cluster or two cluster solution (when excluding both an item on the student union and a general satisfaction item), rather than an eight cluster solution. At the bottom (course) level, the most common cluster solution was two clusters, but with considerable variation, ranging from one to eight clusters. Our findings thus suggest that there is considerable variation in the structure of the NSS and that this variation can depend on analytical level (top national level vs. bottom course level). We review the implications of differing cluster structures for how the NSS is used.

Keywords: Clustering; Student satisfaction; Reliability; Measurement

Word count: 5,460 (body text)

31 Subscales in the National Student Survey (NSS): Some considerations on their structure

32

Introduction.

33 There has been an increasing demand for comparative metrics measuring performance
34 in higher education (e.g., Hazelkorn, 2015). Student satisfaction is at the core of such
35 metrics, and more broadly quality assurance in post-secondary higher education (Chung Sea
36 Law, 2010). For example, students from UK universities are asked to complete a standard
37 survey evaluating their satisfaction with their university and course during the final year of
38 their studies. This survey is called the National Student Survey (NSS). The NSS asks
39 questions about numerous different aspects of the student's experience at university and
40 groups these into various subscales (e.g., the teaching on my course, learning opportunities,
41 assessment and feedback, organisation and management, etc.).

42 The subscales from the NSS have important implications for higher education in the
43 UK. The student's responses to the different subscales contribute to university league tables
44 (e.g., Guardian's university guide). Therefore, higher ratings in specific NSS subscales may
45 result in a university having a higher league table ranking. Given that these league tables
46 may influence a student's decision about where to study (Gibbons, Neumayer, & Perkins,
47 2015), the NSS subscales may indirectly influence university applications. Moreover,
48 universities may use the NSS subscales to alter their practices, teaching and governance (e.g.,
49 Brown, 2011; Senior, Moores, & Burgess, 2017). For example, if an institution or course has
50 lower scores on a particular subscale (e.g., assessment and feedback), they may alter their
51 practices to improve this particular element of the student's experience. Given the potential
52 impact of these subscales, it is important that they are reliable. Therefore, the purpose of
53 this paper is to more closely examine how questions used in the NSS are grouped into
54 subscales and whether these subscales are reliable across different units of analysis (e.g.,
55 across all university students versus across courses within an institution).

56 **Reliability of the National Student Survey (NSS).**

57 The NSS was initially developed in 2005 and has been completed by students on a
58 yearly basis since this date. The initial survey was developed from a larger pool of 45 items
59 and the final version yielded 21 items. These 21 items in the NSS were initially grouped in
60 six subscales; teaching (e.g., “Staff are good at explaining things”); assessment and feedback
61 (e.g., “Assessment arrangements and marking have been fair”); academic support (e.g., “I
62 have received sufficient advice and support with my studies”); organisation and management
63 (e.g., ‘ The course is well organised and is running smoothly’); resources (e.g., “I have been
64 able to access general IT resources when I needed to”); and personal development (e.g., “The
65 course has helped me to present myself with confidence”).

66 Research has found some support for the proposed six-subscale structure of the data
67 (Richardson, Slater, & Wilson, 2007). For example, initial assessment of the data found there
68 to be some support for this model in suggesting there were between five and seven factors
69 (Richardson, 2005). Moreover, an analysis focussing on science subjects supported seven
70 factors (Fielding, Dunleavy, & Langan, 2010). The authors then reduced these to the six
71 factors, in line with the NSS as developed. Importantly, a more recent analysis has found
72 some support for this six-factor solution (Burgess, Senior, & Moores, 2018) and a translation
73 and validation study into Portuguese also supported a six factor structure (Martins et al.,
74 2019). Further research also demonstrates that the items within each subscale form a reliable
75 measure (Bowles, Sharkey, & Day, 2020). Therefore, this research suggested that there was
76 general support for the six NSS subscales, but there was some variation in the exact number
77 of subscales (or factors) extracted between the different studies.

78 Importantly, the NSS survey has been enhanced and developed since it was first
79 introduced to ensure that it meets the changing nature of higher education in the UK
80 (HEFCE, 2014). After undertaking pilot studies (HEFCE, 2015, 2016), the NSS items were
81 revised in 2017 and more items were included. Eight factors were proposed, clustered as

82 follows: The teaching on my course (e.g., “Staff are good at explaining things”), Learning
83 opportunities (e.g., “My course has provided me with opportunities to explore ideas or
84 concepts in depth”), Assessment and feedback (e.g., “The criteria used in marking have been
85 clear in advance”), Academic support (e.g., “I have been able to contact staff when I needed
86 to”), Organisation and management (e.g., “The course is well organised and running
87 smoothly”), Learning resources (e.g., “The IT resources and facilities provided have
88 supported my learning well”), Learning communities (e.g., “I feel part of a community of
89 staff and students”), and Student voice (e.g., “I have had the right opportunities to provide
90 feedback on my course”). These were supplemented with two questions relating to the
91 Student Union (“Q26”: “The students’ union (association or guild) effectively represents
92 students’ academic interests’) and Overall satisfaction (“Q27”: “Overall, I am satisfied with
93 the quality of the course”), respectively. It should be noted that in 2017, the student union
94 question (“Q26”) was grouped with student voice questions (“Q23” - “Q25”; HEFCE, 2016).
95 The items and proposed clusters can be found in Appendix Table A1.

96 Given that the revision to the NSS is relatively new, there has been less research
97 assessing the reliability of the scales. However, there have been some preliminary tests of the
98 reliability of the post-2017 NSS data. For example, smaller-scale pilot research analysed the
99 data on a holistic level across a variety of courses and found support for the proposed eight
100 NSS subscales (HEFCE, 2015, 2016). Therefore, there is some support for the NSS subscales,
101 albeit from smaller-scale research. There has been some more recent research looking at the
102 reliability of the post-2017 NSS data, but this assessed the reliability of the NSS survey as a
103 whole (i.e., as a single scale), rather than looking at individual subscales (Satterthwaite &
104 Vahid Roudsari, 2020). Therefore, further research is needed to assess the reliability of the
105 revised NSS subscales. Given that the revised NSS survey has been implemented, large-scale
106 data are available for a variety of courses and institutions. These existing data could be used
107 to provide a strong test of the proposed eight NSS subscales at different analytical levels.

108 Different strategies can be used to analyse the reliability of the subscales using the
109 available existing NSS data. For example, the simplest form of analysis is to take a holistic
110 approach and combine the data from a variety of institutions and courses. This top level of
111 analysis has been used previously to look at the reliability of the subscales across a variety of
112 subjects and courses (e.g., HEFCE, 2016). This is a useful strategy for providing a general
113 overview of the reliability of the NSS subscales as a whole. However, this approach could
114 cause some issues. From a psychometric point of view (e.g., Nunnally, 1978), relying on
115 aggregate scales could be problematic as it presupposes that the underpinning items do in
116 fact form a coherent scale, across different analytical levels. For example, in the context of
117 the NSS, it may be the case that the data may fit the proposed eight-factor solution at the
118 national level (i.e., the top level), but may not fit this eight-factor solution for some
119 individual courses (i.e., the bottom level). If such courses then make changes to their
120 practices based on the scores from specific NSS subscales, these changes could be based on
121 unreliable data.

122 There is some indirect support for the idea that the structure of the data may vary
123 between institutions and courses. Indeed, research has found variability in the number of
124 feedback questions that were associated with overall satisfaction (Fielding et al., 2010).
125 These researchers found that there were subjects where overall satisfaction was predicted by
126 none (e.g., Biological Sciences), one (e.g., Human Geography), two (e.g., Mathematical
127 Sciences) and all three of the feedback questions (e.g., Physical Sciences). Given that the
128 association between questions within the NSS varied based on the subject under
129 investigation, it suggests that there is a possibility that the structure of the NSS subscales
130 may vary across subject areas. Moreover, research has also argued that the interpretation of
131 items may vary between students, whereby highly-engaged students base evaluations of
132 teaching on being intellectually stimulated and less-engaged students base this on staff
133 enthusiasm (Bennett & Kane, 2014). Although student engagement is likely to vary within a
134 course, it is possible that it may vary between courses and institutions as well. This may

135 mean that the criteria that students use to answer the NSS question may vary between
136 institutions and courses. The potential presence of this variation could mean that the
137 structure of NSS subscales may change between courses and institutions. Therefore, given
138 that the association between NSS questions varies between subjects and that there may be
139 variation in how students answer the questions between courses and institutions, there is a
140 possibility that even if the eight-factor structure fitted the top level data (i.e., combining all
141 courses and institutions at a national level), there may be differences in the structure
142 between individual courses. Therefore, it is also important to also assess whether the
143 proposed eight subscales are found when analysing the data for individual courses.
144 Analysing the data at this bottom level of analysis provides a valuable insight into the
145 reliability of the NSS subscales. If the NSS subscales are reliable, the proposed eight
146 subscales should be present for the vast majority of courses.

147 Despite the importance of assessing the NSS subscales for individual courses, to our
148 knowledge there has been little research determining the reliability of the subscales at this
149 bottom level. Given that course-level data may be used to adapt practices, it is important to
150 ensure the subscales are reliable at this lowest level of analysis. Moreover, assessing whether
151 the proposed eight subscales are present at both the national level and on the majority of
152 individual courses provides a strong test of the reliability of the NSS subscales. Based on
153 this, our aim is to examine whether we can recover the eight proposed question clusters.
154 Importantly, we examined this clustering at both the top (national) level and at both the
155 bottom (course) level. This allowed us to assess the overall structure of the survey at
156 different levels, and to determine the compatibility between the structure at these different
157 levels. The purpose of our paper is not to evaluate the psychometrics of the NSS in its
158 entirety, but rather to start with a smaller goal: are we able to recover the proposed structure
159 in the NSS 1) as a whole to demonstrate the structure of the data at the (top) national level
160 and 2) for individual courses to demonstrate the structure at the (bottom) course level?

Methods

161

162 The data are publicly available from the [National Student Survey website](#). We used
163 the data from the 2019 wave, as the data from the 2020 wave were still being collected at the
164 inception of this study and COVID19 might have impacted the results. The NSS website
165 contains detailed information on how the survey is advertised, how data were collected, the
166 response rates and other methodological aspects, which are beyond the scope of our paper.

167

168 We present results across all the data (“top level”), but also present separate analyses
169 whereby selected all individual subject courses for which we deemed that sufficient data were
170 available (“bottom level”). Based on the heuristic that 10 participants are needed per
171 variable (Harrell, 2001), samples of 270 or greater would be needed to account for the 27
172 questions within the NSS. There were 80 courses satisfying this criterion (lowest level of
173 analysis possible in the public data, “bottom level”). The largest proportion of subjects
174 comprised Business Studies (n = 18 out of 80), but there were courses from across the
175 humanities (e.g., History) and STEM subjects (e.g., Mathematics). The Open University
176 represented the largest proportion of providers (n = 8 out of 80) but there was a
177 representation from both post-92 Universities (i.e., converted polytechnic colleges; e.g.,
178 Northumbria University, Liverpool John Moores University) and universities from the Russell
179 group (e.g., Durham university, University of Warwick), an association of 24 leading UK
180 universities. Similarly, there was geographical variation and universities from Wales and
Northern Ireland were also included in this sample.

181 Data analysis

182

183 All the analyses were conducted in R 4.0.2 (R Development Core Team, 2008). The
184 data, code, and analysis document are available from the [Open Science Framework](#).
185 Clustering methods allow researchers to reduce the complexity in their data (Xu & Wunsch,
2008). In our case, clustering is based on the frequencies to each response category for each
186 of the 27 questions. One straightforward way to do so is via K-means clustering (MacQueen,

187 1967). Simply put, this method works by partitioning the data in such a way that each
188 observation is allocated into k clusters. Using an algorithmic approach, the goal is to
189 minimise the Euclidean distance to each centre of a proposed cluster. A variety of methods
190 have been proposed to find a solution to identifying the optimal number of clusters. We use
191 the “NBclust” package to examine a large array of clustering methods based on Euclidean
192 Distances (Charrad, Ghazzali, Boiteau, & Niknafs, 2014). This approach allowed us to
193 simultaneously evaluate 27 different clustering methods for the data. Due to space
194 constraints we do not discuss these, but see Charrad et al. (2014) for an exhaustive
195 discussion of the methods used. Following best practice, we then rely on the majority rule to
196 determine the optimal number of clusters proposed for the data (i.e. the mode, the number
197 which appears most often in the set). We then explore these clusters further and visualise
198 these (Kassambara & Mundt, 2017). It is important to note that clusters can contain just a
199 single element, thus in our case allowing for a single item to be on its own (e.g., “Q27”,
200 general satisfaction).

201 Our analysis document also contains further analyses (e.g., X-means clustering, Pelleg
202 & Moore, 2000; Jain, 2010; but also exploratory factor analyses, implemented via the “psych”
203 package, Revelle, 2016) and robustness checks not reported here. The choice of analysis level
204 can lead to different conclusions - as mentioned above, we focussed on the “top level” and
205 the “bottom level” of analysis. However, our code can also be easily amended to conduct
206 similar analyses but grouped at subject course or university level, for example.

207 **Results**

208 **Heat Map and Pearson correlation matrices.**

209 There were between 366,424 (“Q26”) and 386,683 (“Q15”) responses to each question.
210 It is important to note that response rates differ by less than 5.5%, therefore response bias is
211 unlikely to strongly impact our results at aggregate level. Figure 1 shows a heat map based
212 on the response frequencies. The question on Overall satisfaction (“Q27”) demonstrates that

213 students are generally positive. The question on the student union (“Q26”) shows that the
 214 responses to this question are somewhat more negative.

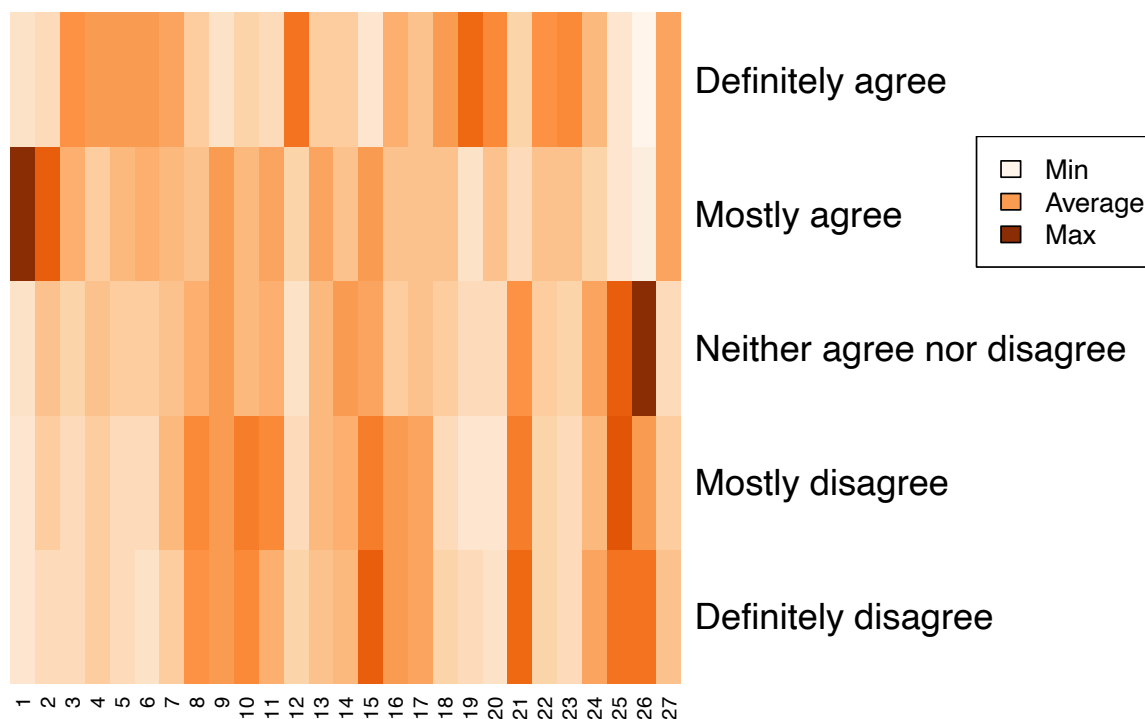


Figure 1. Heat map based on frequencies

215 Figure 2 demonstrates the Pearson correlations of the aggregated data. It is clear that
 216 all variables correlate moderately to very strongly. The weakest correlations are with “Q26”
 217 (*The students’ union (association or guild) effectively represents students’ academic*
 218 *interests*). Note that this is also the question with the lowest response rate.

219 Clustering

220 **Top level analysis - all data.** Twenty-seven clustering methods were evaluated but
 221 one failed to converge leaving 26 cluster solutions to be evaluated. The frequency
 222 distribution is summarised in Figure 3. Incidentally, removing the general satisfaction
 223 question, also led to a four cluster solution [see OSF](#). Figure 4 shows the distribution of the
 224 cluster solutions, when the general satisfaction is excluded.

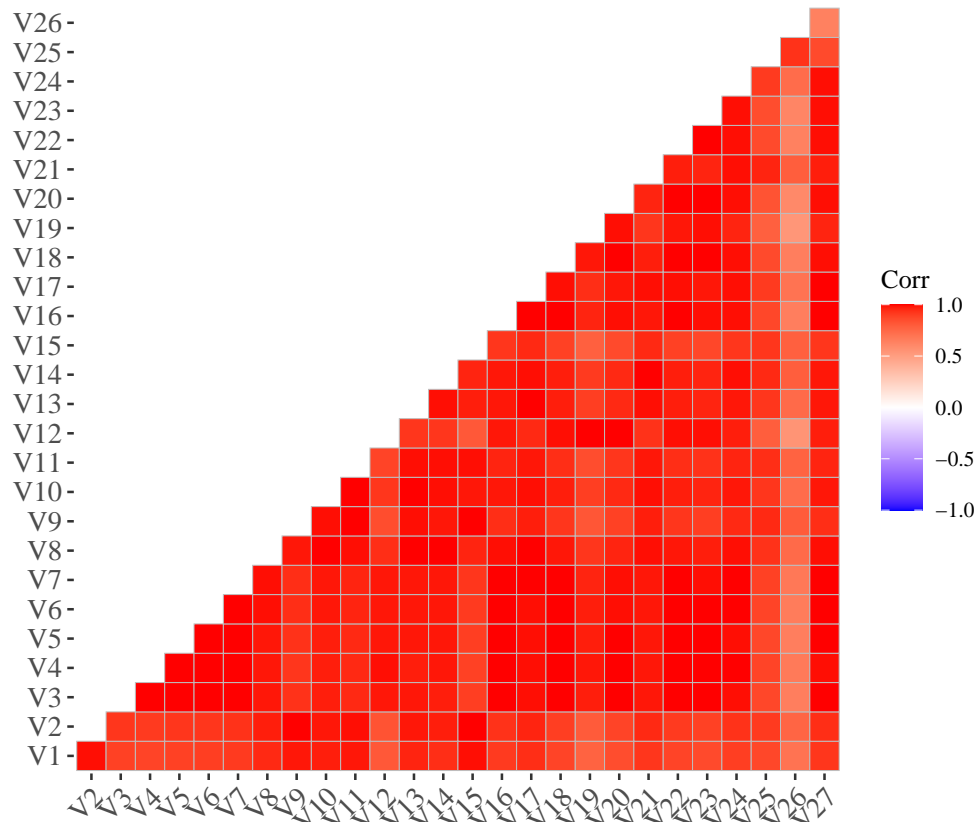


Figure 2. Heat map with aggregated correlations for each of the 27 variables

225 Next, we used K-Means clustering to visualise the proposed structure for a four cluster
 226 solution. Figure 5 displays the four clusters in two dimensions. The largest cluster is in pink.
 227 this cluster contains all items on Learning Opportunities (“Q5” to “Q7”), but it also contains
 228 a myriad of other items (e.g., Items relating to Organisation and management
 229 (“Q16”, “Q17”), but also items relating to Student Voice, “Q23” and “Q24”). It also contains
 230 the overall satisfaction question (“Q27”). It is difficult to label this cluster but we propose to
 231 label it as “general satisfaction”, given that it contains the satisfaction item and likely the
 232 items in this cluster are closely related to general satisfaction. The second largest cluster is
 233 in green. It contains all items relating to “Assessment and feedback (’Q8 to Q11”). However,
 234 this cluster also contains some items for Teaching on my course (“Q1” and “Q2”), Academic
 235 support (“Q13” and “Q14”), and organisation and assessment (“Q15”). What seems to

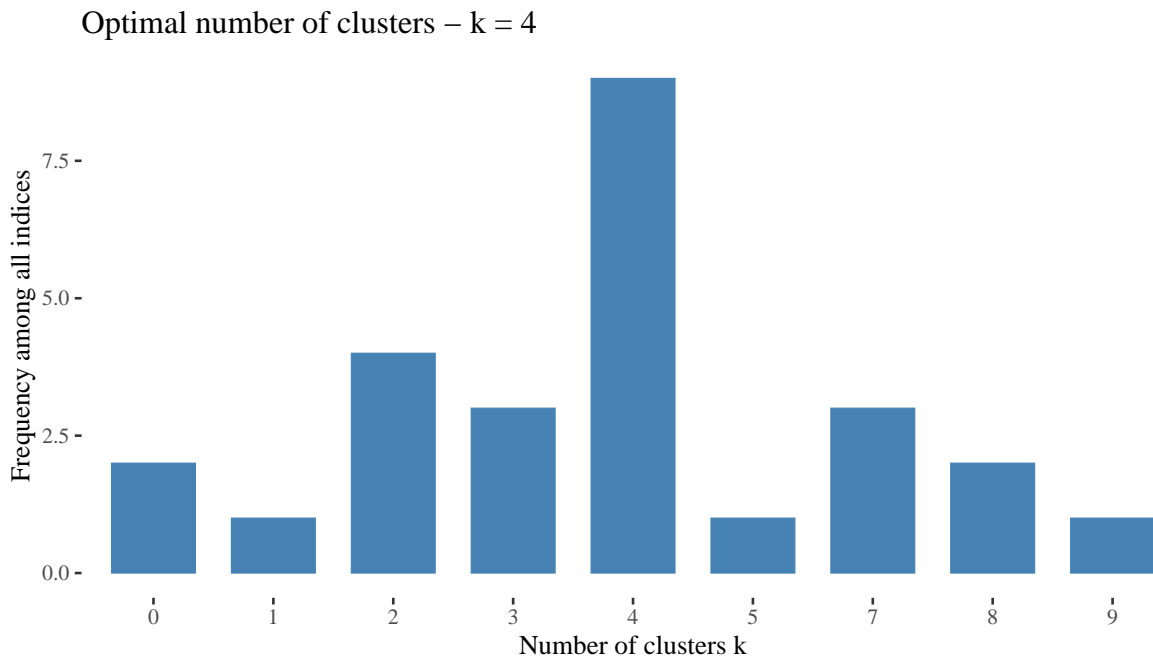


Figure 3. Frequency distribution for optimum clustering

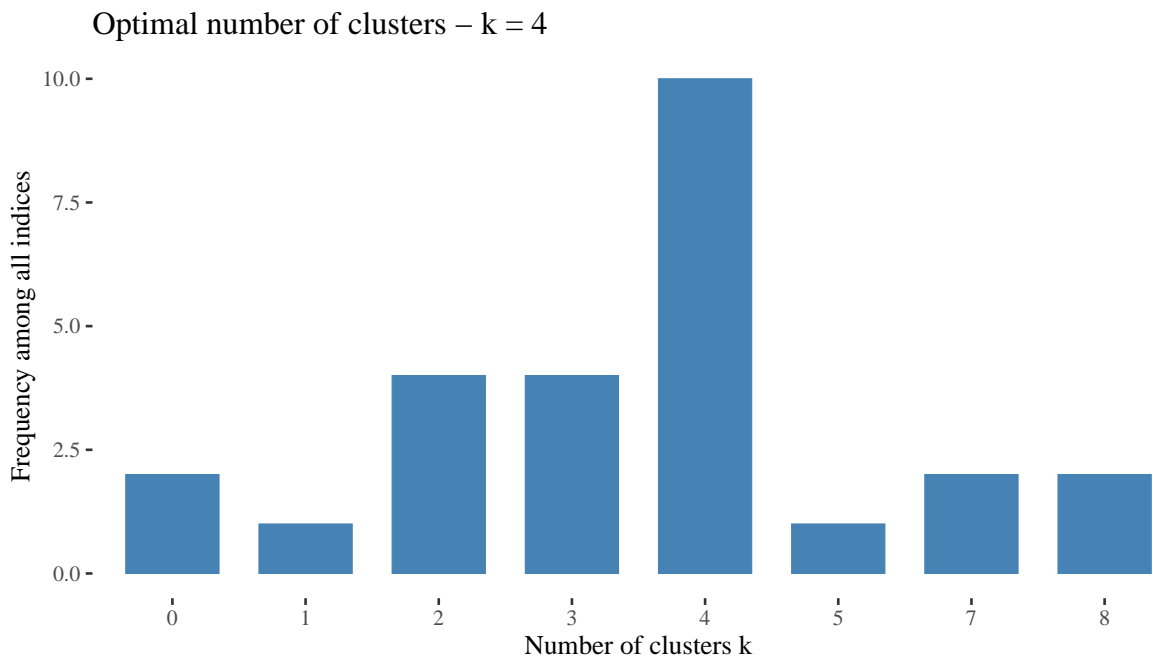


Figure 4. Frequency distribution for optimum clustering (without general satisfaction item, 'Q27')

236 connect most of these items is that they tend to relate to staff, we refer to this factor as
237 “Staff”. The two remaining clusters, purple and orange, were smaller. The purple cluster
238 contains two items from Learning resources (“Q19-Q20”: “The library resources (e.g. books,
239 online services and learning spaces) have supported my learning well” and “I have been able
240 to access course-specific resources (e.g. equipment, facilities, software, collections) when I
241 needed to”) and one item relating to academic support (“Q12”: “I have been able to contact
242 staff when I needed to”). We tentatively label this cluster as “Resources”. The orange cluster
243 contains a question on the student union (“Q26”) is grouped with one item on Student Voice
244 (“It is clear how students’ feedback on the course has been acted on’), and one item relating
245 to Learning community (“I feel part of a community of staff and students”). We tentatively
246 label this cluster as “Community”.

247 Importantly, the proposed clustering is quite clearly different for some of the proposed
248 structures. For example, the items related Teaching on my course (“Q1” to “Q4”) are
249 divided over separate clusters.

250 It could be argued that we did not find the proposed structure because we included the
251 overall satisfaction item in our analysis. This is unlikely as individual items could also fail to
252 clearly cluster with other items. Nonetheless, we repeated the analysis with this item
253 removed (details on [OSF](#)). Figure 6 illustrates the four cluster structure when the general
254 satisfaction item is excluded. The clusters identified are different from above, which is to be
255 expected. However, upon closer inspection it shows that the spatial layout is quite similar, it
256 is just that the clustering method has drawn different boundaries. For example, again, the
257 items related Teaching on my course (“Q1” to “Q4”) are divided over separate clusters. Also,
258 we again find that the clustering is quite different from the proposed structure.

259 One could also argue that the item relating to the student union “Q26” should
260 similarly be excluded (but note that it is spatially very close to “Q25”, suggesting that it
261 does align with “Student voice” and it was initially conceived to be part of student voice).

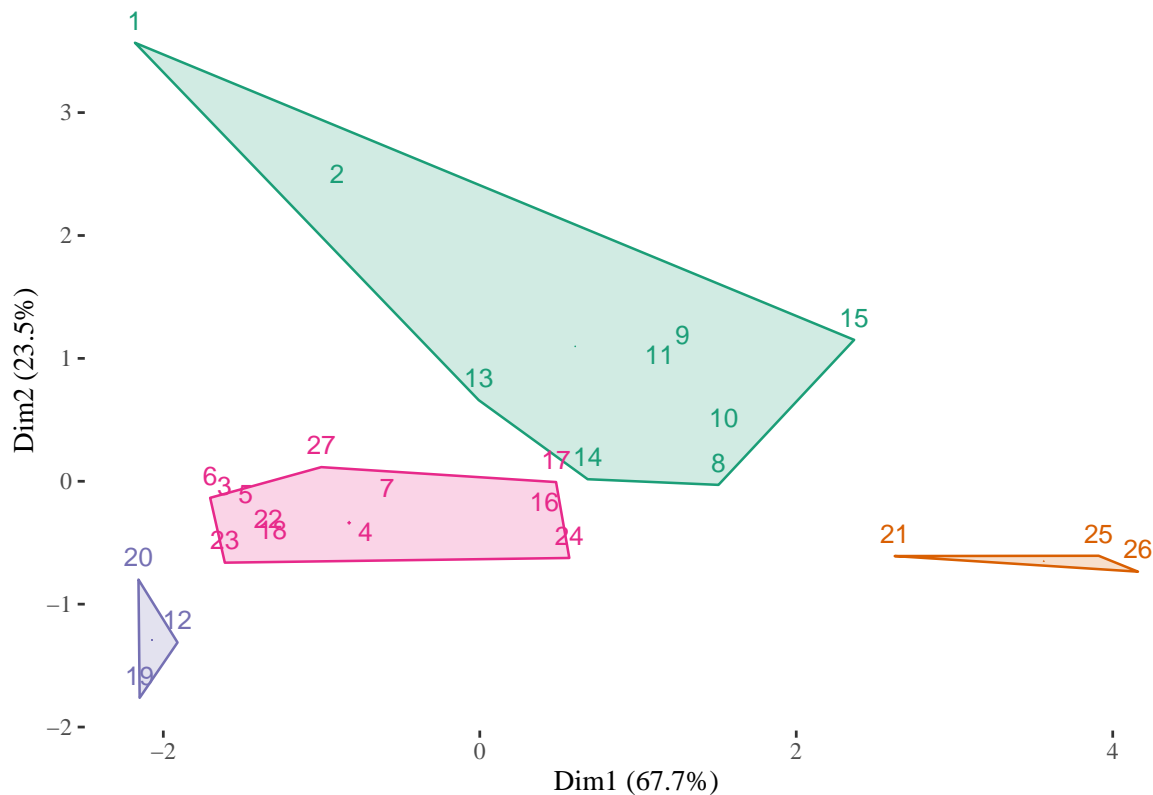


Figure 5. Proposed clustering based on K-means clustering. Numbers correspond to NSS question numbers.

262 When repeating the exercise with exclusion of “Q26” and “Q27”, we find a two cluster
 263 solution (Figure 7), rather than a four cluster solution. However, the spatial layout of the
 264 items is quite similar to Figure 6, but we now end up with fewer clusters. Importantly, this
 265 structure does not clearly align with the proposed eight cluster solution. For example, the
 266 items related Teaching on my course (“Q1” to “Q4”) are again divided over separate clusters.

267 **Bottom level analysis - specific course subjects.** For two courses there were
 268 convergence issues and optimal clustering for the 27 clustering methods could not be
 269 determined. The frequency distribution for the optimal clusters for the remaining 78 courses
 270 are shown in Figure 8. The most common proposed number of clusters is 2 (32 out of 78).
 271 Yet, there is considerable variability, with 22 out of 78 subjects having a cluster solution of 3

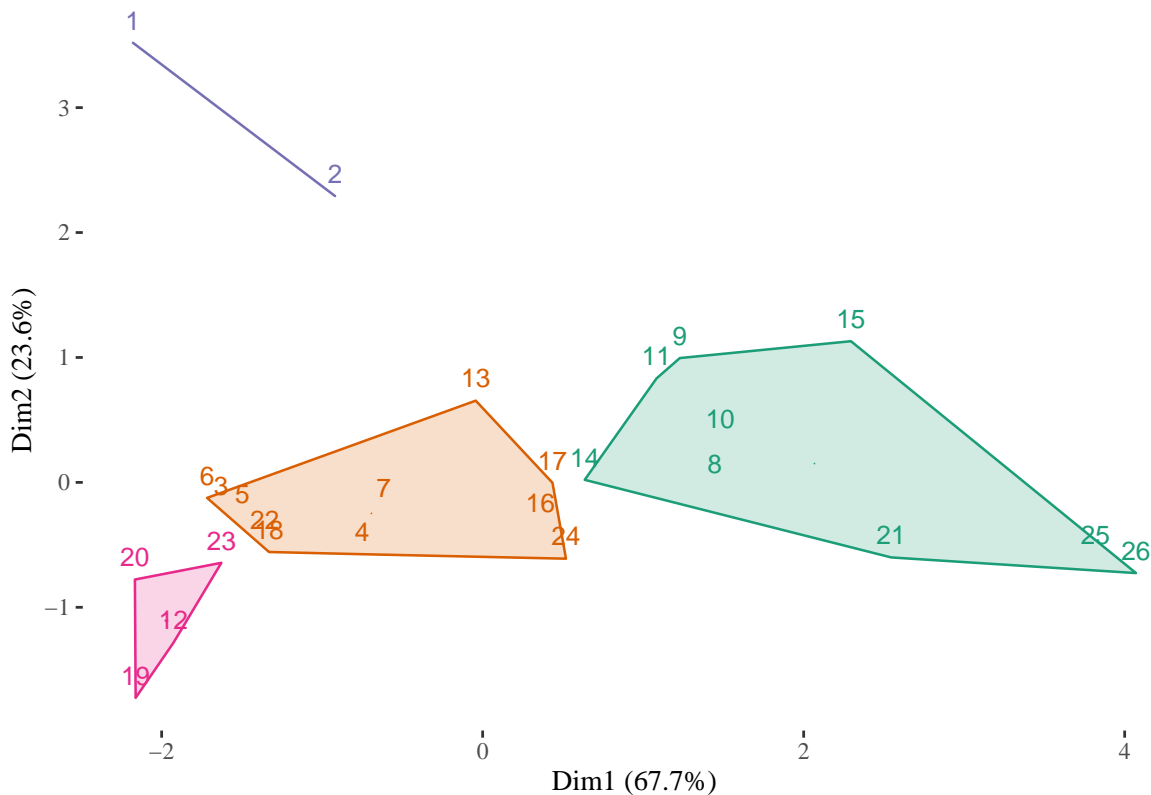


Figure 6. Proposed clustering based on K-means clustering (without 'Q27' relating to general satisfaction). Numbers correspond to NSS question numbers.

272 and 15 out of 78 subjects having a cluster solution of 1. For only 1 out of 78 subject courses
 273 the majority rule suggested eight clusters, but the structure does not align with the proposed
 274 clusters (see OSF). What is clear, however, is that depending on the course one would end
 275 up with very different groupings (1, 2 or 3 clusters) and that these groupings do not align
 276 clearly with the proposed division into eight clusters.

277 Even if the same number of clusters is proposed, we can have quite different groupings.
 278 We illustrate this in Figure 9, with two courses from the Open University (Counselling,
 279 psychotherapy and occupational therapy (“counselling”) and Mathematics), for which there
 280 is a two cluster solution. While there is some overlap (e.g., “Q21”, “Q22”, “Q24”, “Q25”,
 281 “Q26” feature in both clusters 2), there are also notable differences. For example, two items

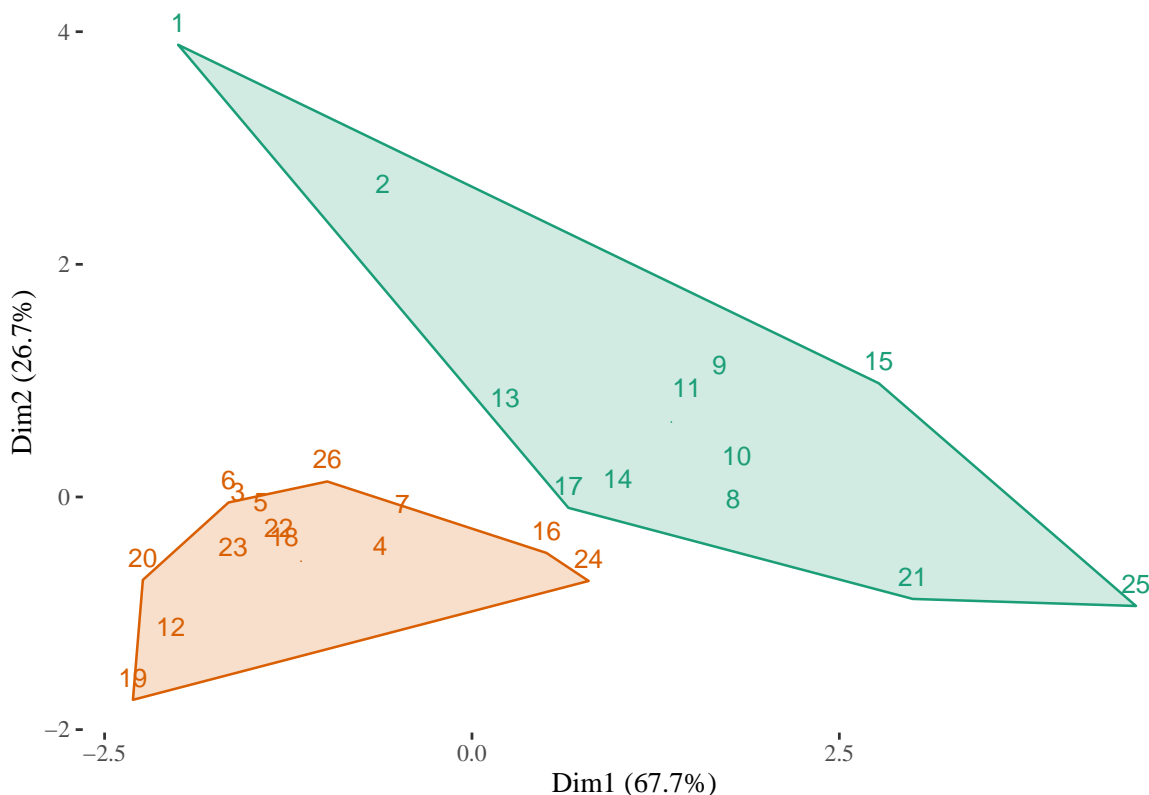


Figure 7. Proposed clustering based on K-means clustering (without 'Q26' relating to the student union and 'Q27' relating to general satisfaction). Numbers correspond to NSS question numbers.

282 from “Learning opportunities” (“Q6” and “Q7”) are part of the second cluster for
 283 Mathematics but are not included in cluster 2 for counselling. Mathematics’ second cluster
 284 also includes “Q19” (“The library resources (e.g. books, online services and learning spaces)
 285 have supported my learning well”). Perhaps more problematic is that these two clusters bear
 286 little resemblance with the proposed eight clusters.

287

Discussion

288

The NSS is an important assessment tool in higher education in the UK. In this study,
 289 we aimed to determine the structure of these data. We found variability in the structure of
 290 the NSS data, depending on the level of analysis. At the top (national) level, we found a four

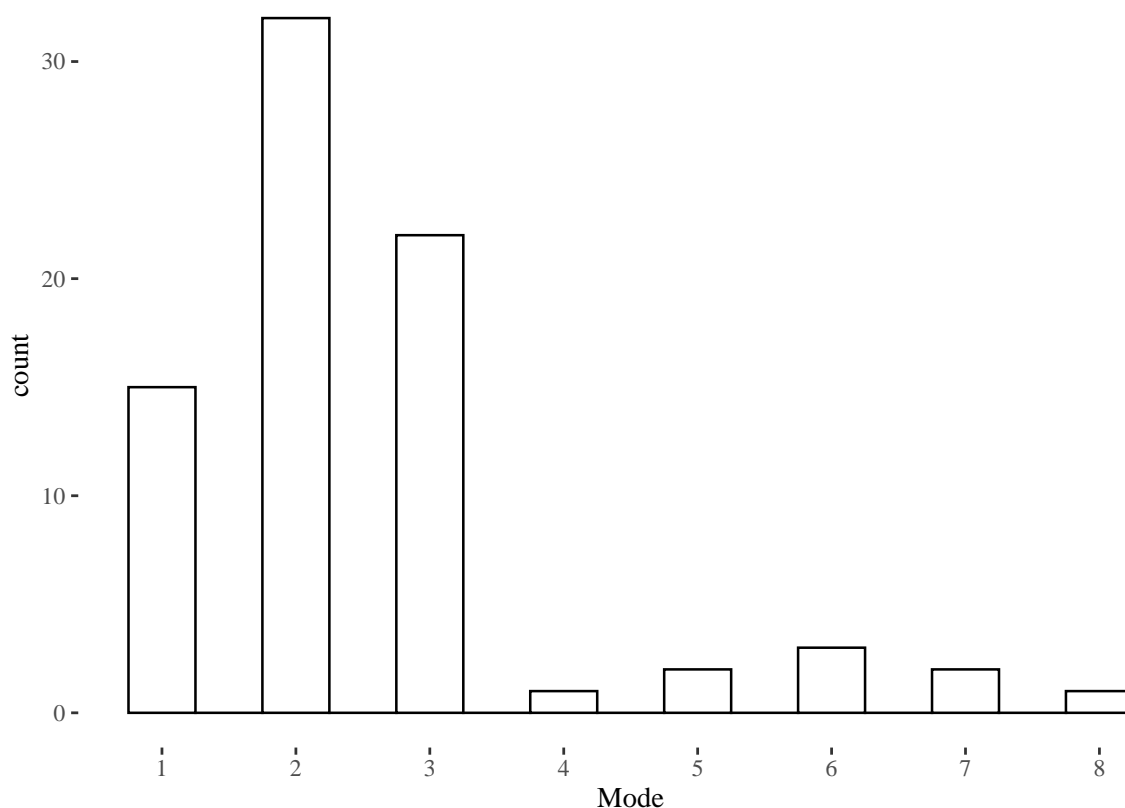


Figure 8. frequency distribution of optimal clusters for 78 course subjects

291 cluster solution for this data, which we labelled as General Satisfaction, Staff, Resources, and
 292 Community. Even though we found a two cluster solution when we excluded both the item
 293 about the student union (“Q26”) and the general satisfaction item (“Q27”), positions of
 294 individual items corresponded largely to the previously documented four cluster solution. At
 295 the bottom (course) level of analysis, we found that the number of clusters varies across
 296 different courses. A two cluster solution was most common among courses. However, there
 297 was also a substantial number of courses that contained either one or three clusters.
 298 Therefore, at both the national and course level, we do not find substantial support for the
 299 proposed eight-cluster solution.

300 It should be noted that some research has found support for the structure proposed by
 301 the NSS. For example, prior to the revision of the NSS in 2017, numerous studies found some

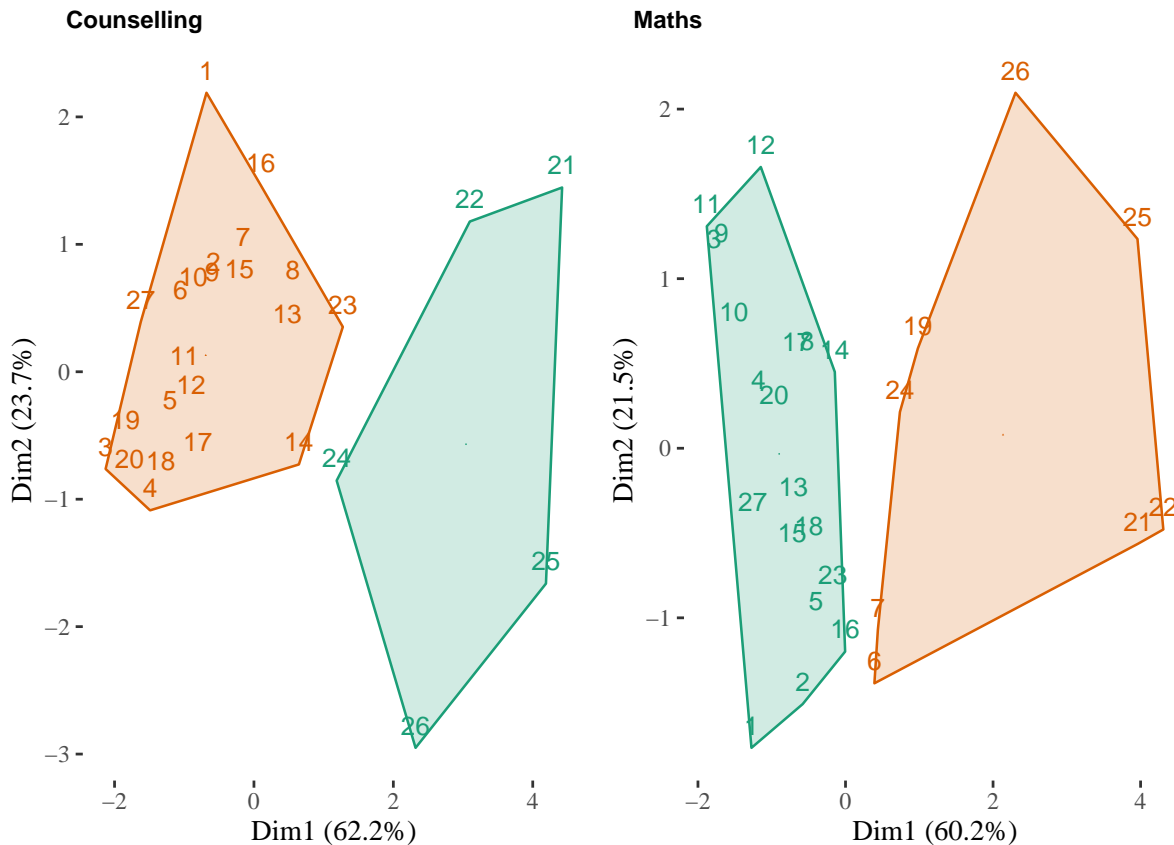


Figure 9. Illustration of two cluster structure in two Open University courses. Numbers correspond to NSS question numbers.

302 support for the six-factor solution (Fielding et al., 2010; Richardson, 2005; Richardson et al.,
 303 2007). We may have found different results than these studies for numerous reasons. For
 304 example, we analysed data from the post-2017 NSS, which contained more items. The
 305 inclusion of these items may have altered the structure of the data. Also there are differences
 306 in the order and content of items (Office for Students, 2020b), which might have affected the
 307 structure. Moreover, much of this work was undertaken on early NSS data. Recent research
 308 suggests that there has been a general rise in NSS results over the years leading to a ceiling
 309 effect (Burgess et al., 2018; Langan & Harris, 2019). This general rise in satisfaction over the
 310 years and ceiling effect may make it more difficult to differentiate between the different
 311 factors in the 2019 data that we used for this analysis. However, these ideas cannot explain

312 why we found different results from more recent research (HEFCE, 2016). One possible
313 reason for this is that the solution that is found may depend on the way that the analysis is
314 undertaken. For example, we found differences in the results when we analysed the data at
315 the national and course level. Similarly, we found slight differences depending on whether or
316 not the satisfaction item and student union item were included into the analyses. There may
317 also be other differences that occur depending on the analysis strategy. The solution may
318 vary depending on a) whether the number of solutions is determined based on a-priori
319 assumptions or statistical techniques, b) the courses that were included in the analysis, or c)
320 whether primary data is used rather than the secondary data available on the NSS website.
321 However, the fact that the solution may vary based on the type of analysis suggests that
322 further research is needed to assess the reliability of the proposed clustering of questions.

323 **Limitations and future research**

324 It is important to consider the limitations of this study. There is probably a large
325 number of ways in which one could divide up the NSS data. For example, one could repeat
326 the clustering exercise which we performed by course subject (ignoring that they are
327 clustered within universities) or by university (ignoring clustering by subject), or by
328 geography (clustering by country or, for example, by metropolitan area). As is already clear
329 from our analysis, the choice of the level analysis will impact the answer one gets (e.g.,
330 Simpson, 1951; Robinson, 1950). There is likely no “correct” answer as to which level of
331 analysis is best-suited, as that will depend on the unit of analysis (e.g., within a university
332 comparing subjects, versus comparing universities within a region). However, what is clear,
333 at least in our analysis, is that there is no consistent structure in line with the proposed
334 eight cluster structure at the aggregate level or course subject level. It is possible that at the
335 level of the individual respondent yet a different pattern arises, but note that these data are
336 not public. More importantly, what is fed forward in metrics is usually based on some
337 aggregate level, rather than at the individual level.

338 It is important to bear in mind that we have only investigated one aspect of
339 measurement in the NSS. There are a whole host of other research questions which need to
340 be addressed to ensure that the NSS scales are valid and reliable (e.g., Anastasi, 1976;
341 Borsboom, 2005; Finch & French, 2018). For example, a common measure for reliability is
342 the test-retest correlation of items: do participants respond to the items of a scale in a similar
343 fashion, when they retake a scale three months later, for example. Future research assessing
344 test-retest reliability of the NSS subscales would be valuable. Another aspect which needs to
345 be considered is measurement invariance (e.g., Meredith, 1993). Comparisons between
346 groups are only valid if we are able to reliably recover the same psychological constructs in
347 each group. This is a well-known issue in cross-cultural measurement (e.g., Milfont & Fischer,
348 2010), but perhaps lesser known in the context of Higher Education. In order to be able to
349 directly compare universities or courses, we thus need to be sure that the *same* structure is
350 underpinning each of those. This is typically established via multigroup structural equation
351 modelling (e.g., Mair, 2018). Our preliminary exploration via cluster analysis suggests that
352 there likely is wide variation in the dimensional structure at course level. However, further
353 work is necessary to establish the potential impact on metrics as they are used. Moreover, an
354 “ideal” measure should exhibit invariance across a whole range of relevant grouping variables
355 (e.g., gender, age, ethnicity, full time vs. part time students, studying at post-92 versus
356 Russell group university, studying STEM vs. humanities subjects). Although there is some
357 work assessing this (e.g., Richardson et al., 2007), we call for more work demonstrating that
358 the NSS consistently demonstrates the same structure across a large number of groupings.

359 Another important consideration is the consistency of the data year-on-year. Previous
360 research using early NSS data found consistency in university ranking across years (Cheng &
361 Marsh, 2010). However, it is also important to assess the consistency in the clustering
362 year-on-year. We conducted our analyses on the data from a single year. From these data,
363 we showed variation in the structure of the data depending on the level of analysis, and that
364 the cluster solution may vary between courses. It is possible that the solution for the

365 national data and the course-level data may be consistent from year-to-year. However, it is
366 also possible that both these solutions may vary each year. It was beyond the scope of this
367 research to assess the reliability of these solutions across the number of years. Instead, we
368 focused on the general reliability of the solution at both the national and course level.
369 However, it is important for future research to determine the extent to which these solutions
370 are reliable from year-to-year. This will allow universities to determine whether improving
371 one cluster is likely to be effective in subsequent years.

372 **Practical implications**

373 The NSS data underpin important metrics that are used in numerous ways. Indeed,
374 the data is included in university league tables (e.g., Guardian university guide) and
375 university assessments into teaching standards (i.e., the TEF). The data are also used within
376 universities to improve the student experience at both the institutional and course level.
377 Students may also use this data to determine where they wish to study (Gibbons et al.,
378 2015). Given this, it is important to consider how these data can be used effectively. This
379 study suggests that using the aggregated data may be problematic. Indeed, we found
380 discrepancies between the implicit solution that is often applied and our data. At the
381 national (top) level analysis, we found either a four or two cluster solution, rather than the
382 proposed eight cluster solution. Moreover, the exact nature of these clusters varied
383 depending on the analysis that was undertaken (i.e., whether the overall satisfaction and/or
384 student union items were included in the analysis). This discrepancy from the frequently
385 applied solution and the variation based on the type of analysis suggests that the aggregated
386 data should be used with caution.

387 We also found that the solution varied between institutions at course level. Although a
388 two cluster solution was most common, there were a substantial number of courses where the
389 data produced either a single cluster or three cluster solution. This suggests that
390 comparisons between courses based on the aggregated data structure may be problematic.

391 Moreover, our illustration between two courses within the same university suggests that even
392 comparisons between courses within the same institution may be difficult. This is not the
393 first study to suggest that comparisons using the NSS data should be interpreted with
394 caution. For example, researchers have suggested that as students with approaches to
395 learning vary in their interpretation of the questions, comparing different subjects and
396 institutions is especially difficult (Bennett & Kane, 2014). Here, we add to this argument by
397 suggesting that comparisons based on the aggregate data may be difficult as the structure of
398 these data varies between courses.

399 Issues with the NSS have been raised by academics (Bell & Brooks, 2018; Lenton, 2015;
400 Sabri, 2013; Senior et al., 2017; Yorke, 2009) and government bodies (Department for
401 Business, Energy & Industrial Strategy, & Department for Education, 2020). However, it is
402 important to note that we are not questioning the usefulness of the NSS survey. Indeed, the
403 NSS has numerous strengths. These strengths include a substantial rise in overall student
404 satisfaction across the board (Burgess et al., 2018; Langan & Harris, 2019), high response
405 rates (Office for Students, 2020a), and reducing the burden on universities to collect data on
406 satisfaction (Office for Students, 2021). Instead, we argue that it is important to carefully
407 consider the use of the aggregate data. If the aggregate data are used to inform policy
408 decisions at course level, it is important to determine whether the structure of the data at
409 the course level is indeed similar, before implementing changes to courses. Alternatively, an
410 individual-item approach could be used rather than the proposed clustered scales. For
411 example, recent research has demonstrated the effectiveness of using individual-item
412 approaches to identify strategies for improving overall satisfaction (Langan & Harris, 2019;
413 Satterthwaite & Vahid Roudsari, 2020). Moreover, text comments from the NSS are also
414 used to consider how changes could be made to improve practice (Langan, Scott, Partington,
415 & Oczujda, 2017), which could be considered as another type of individual approach. As
416 such, individual-item and respondent based approaches can be used effectively to enhance
417 the student experience following feedback from the NSS.

Conclusion

418
419 It is important to ensure that the proposed NSS subscales are reliable. Our analyses
420 suggest that clustering of such items into scales is likely ambiguous and we have
421 demonstrated other groupings than the proposed eight dimensions. At the top (national)
422 level, we found the questions were clustered into two or four clusters, depending on the
423 analytical approach. Similarly, at the bottom (individual course) level there was a wide
424 range in the number of clusters, with two clusters being most common among courses. The
425 subscales within the NSS are an important metric for UK universities. These subscales are
426 included into university league tables. These league tables are used by students to determine
427 where to study. As such, the NSS may influence university applications. Moreover,
428 institutions and courses may alter their practices based on the results of the NSS. Given that
429 the data did not show support for the proposed eight subscales, it is important to carefully
430 consider how the NSS is used by league tables and institutions. The proposed aggregated
431 data may not fit the structure of the data for students on a particular course. As such, the
432 use of the proposed subscales may be problematic. Instead, we argue that it may be useful
433 to focus on the individual items. Moreover, given these findings, we call for further research
434 to test the validity and reliability of the NSS clusters.

Acknowledgments

435
436 (To be included)

References

- 437
438 Anastasi, A. (1976). *Psychological testing* (fourth edition). New York, NY: Macmillan.
- 439 Bell, A. R., & Brooks, C. (2018). What makes students satisfied? A discussion and analysis
440 of the UK's national student survey. *Journal of Further and Higher Education*, 42(8),
441 1118–1142. <https://doi.org/10.1080/0309877X.2017.1349886>

- 442 Bennett, R., & Kane, S. (2014). Students' interpretations of the meanings of questionnaire
443 items in the National Student Survey. *Quality in Higher Education*, 20(2), 129–164.
444 <https://doi.org/10.1080/13538322.2014.924786>
- 445 Borsboom, D. (2005). *Measuring the mind: Conceptual issues in contemporary*
446 *psychometrics*. Cambridge, UK: Cambridge University Press.
- 447 Bowles, D., Sharkey, G., & Day, C. (2020). Psychological predictors of National Student
448 Survey course satisfaction. *Journal of Perspectives in Applied Academic Practice*,
449 8(2), 7–15.
- 450 Brown, S. (2011). Bringing about positive change in the higher education student experience:
451 A case study. *Quality Assurance in Education*, 19(3), 195–207.
452 <https://doi.org/10.1108/096848811111158027>
- 453 Burgess, A., Senior, C., & Moores, E. (2018). A 10-year case study on the changing
454 determinants of university student satisfaction in the UK. *PloS One*, 13(2), e0192976.
455 <https://doi.org/10.1371/journal.pone.0192976>
- 456 Charrad, M., Ghazzali, N., Boiteau, V., & Niknafs, A. (2014). NbClust: An R Package for
457 Determining the Relevant Number of Clusters in a Data Set. *Journal of Statistical*
458 *Software*, 61(6), 1–36. <https://doi.org/10.18637/jss.v061.i06>
- 459 Cheng, J. H. S., & Marsh, H. W. (2010). National Student Survey: Are differences between
460 universities and courses reliable and meaningful? *Oxford Review of Education*, 36(6),
461 693–712. <https://doi.org/10.1080/03054985.2010.491179>
- 462 Chung Sea Law, D. (2010). Quality assurance in post-secondary education: The student
463 experience. *Quality Assurance in Education*, 18(4), 250–270.
464 <https://doi.org/10.1108/09684881011079125>

- 465 Department for Business, Energy & Industrial Strategy, & Department for Education.
466 (2020). Reducing bureaucratic burden in research, innovation and higher education.
467 Retrieved April 20, 2021, from
468 [https://www.gov.uk/government/publications/reducing-bureaucratic-burdens-](https://www.gov.uk/government/publications/reducing-bureaucratic-burdens-higher-education/reducing-bureaucratic-burdens-on-research-innovation-and-higher-education)
469 [higher-education/reducing-bureaucratic-burdens-on-research-innovation-and-higher-](https://www.gov.uk/government/publications/reducing-bureaucratic-burdens-on-research-innovation-and-higher-education)
470 [education](https://www.gov.uk/government/publications/reducing-bureaucratic-burdens-on-research-innovation-and-higher-education)
- 471 Fielding, A., Dunleavy, P. J., & Langan, A. M. (2010). Interpreting context to the UK's
472 national student (satisfaction) survey data for science subjects. *Journal of Further*
473 *and Higher Education*, 34(3), 347–368.
474 <https://doi.org/10.1080/0309877X.2010.484054>
- 475 Finch, W. H., & French, B. F. (2018). *Educational and psychological measurement*. London,
476 UK: Routledge.
- 477 Gibbons, S., Neumayer, E., & Perkins, R. (2015). Student satisfaction, league tables and
478 university applications: Evidence from Britain. *Economics of Education Review*, 48,
479 148–164. <https://doi.org/10.1016/j.econedurev.2015.07.002>
- 480 Harrell, F. E. (2001). *Regression Modeling Strategies*. New York, NY: Springer New York.
481 <https://doi.org/10.1007/978-1-4757-3462-1>
- 482 Hazelkorn, E. (2015). *Rankings and the reshaping of higher education: The battle for*
483 *world-class excellence* (2nd Edition). New York, NY: Springer.
- 484 HEFCE. (2014). Review of the National Student Survey. Retrieved April 22, 2021, from
485 <https://natcen.ac.uk/media/457944/nss-review-summary.pdf>
- 486 HEFCE. (2015). UK review of information about higher education: Results and analysis for
487 the 2015 pilot of the National Student Survey. Retrieved from
488 https://dera.ioe.ac.uk/24462/1/HEFCE2015_25.pdf

- 489 HEFCE. (2016). Review of information about learning and teaching, and the student
490 experience - Results and analysis of the 2016 pilot of the National Student Survey.
491 Retrieved from https://dera.ioe.ac.uk/27588/1/HEFCE2016_27.pdf
- 492 Jain, A. K. (2010). Data clustering: 50 years beyond K-means. *Pattern Recognition Letters*,
493 *31*(8), 651–666. <https://doi.org/10.1016/j.patrec.2009.09.011>
- 494 Kassambara, A., & Mundt, F. (2017). Package “factoextra”. Retrieved from
495 <https://rpkgs.datanovia.com/factoextra/index.html>
- 496 Langan, A. M., & Harris, W. E. (2019). National student survey metrics: Where is the room
497 for improvement? *Higher Education*, *78*(6), 1075–1089.
498 <https://doi.org/10.1007/s10734-019-00389-1>
- 499 Langan, A. M., Scott, N., Partington, S., & Oczujda, A. (2017). Coherence between text
500 comments and the quantitative ratings in the UK’s National Student Survey. *Journal*
501 *of Further and Higher Education*, *41*(1), 16–29.
502 <https://doi.org/10.1080/0309877X.2014.1000281>
- 503 Lenton, P. (2015). Determining student satisfaction: An economic analysis of the National
504 Student Survey. *Economics of Education Review*, *47*, 118–127.
505 <https://doi.org/10.1016/j.econedurev.2015.05.001>
- 506 MacQueen, J. (1967). Some methods for classification and analysis of multivariate
507 observations. In L. Lecam & J. Neyman (Eds.), *Proceedings of the fifth Berkeley*
508 *symposium on mathematical statistics and probability* (Vol. 14, pp. 281–297).
509 Berkeley, CA: UCLA Press.
- 510 Mair, P. (2018). *Modern Psychometrics with R*. New York, NY: Springer International
511 Publishing.

- 512 Martins, M. J., Marques, T. R., Laíns, I., Leal, I., Pessanha, I., Brochado, B., . . .
513 Richardson, J. T. E. (2019). The national student survey: Validation in portuguese
514 medical students. *Assessment & Evaluation in Higher Education*, 44(1), 66–79.
515 <https://doi.org/10.1080/02602938.2018.1475547>
- 516 Meredith, W. (1993). Measurement invariance, factor analysis and factorial invariance.
517 *Psychometrika*, 58(4), 525–543. <https://doi.org/10.1007/BF02294825>
- 518 Milfont, T. L., & Fischer, R. (2010). Testing measurement invariance across groups:
519 Applications in cross-cultural research. *International Journal of Psychological*
520 *Research*, 3(1), 111–130. <https://doi.org/10.21500/20112084.857>
- 521 Nunnally, J. C. (1978). *Psychometric theory*. New York: McGraw-Hill.
- 522 Office for Students. (2020a). National Student Survey 2020 : Analysis of the impact of the
523 coronavirus pandemic. Retrieved from
524 [https://www.officeforstudents.org.uk/media/659497ab-d2aa-4b1f-9b84-](https://www.officeforstudents.org.uk/media/659497ab-d2aa-4b1f-9b84-fdd4e65dfb6b/nss-2020-analysis-of-impact-of-coronavirus-pandemic.pdf)
525 [fdd4e65dfb6b/nss-2020-analysis-of-impact-of-coronavirus-pandemic.pdf](https://www.officeforstudents.org.uk/media/659497ab-d2aa-4b1f-9b84-fdd4e65dfb6b/nss-2020-analysis-of-impact-of-coronavirus-pandemic.pdf)
- 526 Office for Students. (2021). NSS review phase one report. Retrieved from
527 [https://www.officeforstudents.org.uk/media/b6ad8f44-f532-4b55-aa32-](https://www.officeforstudents.org.uk/media/b6ad8f44-f532-4b55-aa32-7193497ddf92/nss-review-phase-1-report.pdf)
528 [7193497ddf92/nss-review-phase-1-report.pdf](https://www.officeforstudents.org.uk/media/b6ad8f44-f532-4b55-aa32-7193497ddf92/nss-review-phase-1-report.pdf)
- 529 Office for Students. (2020b, February 19). The National Student Survey: Consistency,
530 controversy and change. Retrieved April 9, 2021, from
531 [https://www.officeforstudents.org.uk/publications/the-national-student-survey-](https://www.officeforstudents.org.uk/publications/the-national-student-survey-consistency-controversy-and-change/)
532 [consistency-controversy-and-change/](https://www.officeforstudents.org.uk/publications/the-national-student-survey-consistency-controversy-and-change/)
- 533 Pelleg, D., & Moore, A. W. (2000). X-means: Extending K-means with Efficient Estimation
534 of the Number of Clusters. In *ICML* (pp. 727–734).

- 535 R Development Core Team. (2008). R : A language and environment for statistical
536 computing.
- 537 Revelle, W. (2016). Psych: Procedures for personality and psychological research. Retrieved
538 from <https://CRAN.R-project.org/package=psych>
- 539 Richardson, J. T. E. (2005). National Student Survey: Interim assessment of the 2005
540 questionnaire. Retrieved from https://dera.ioe.ac.uk/5860/1/rd20_05.pdf
- 541 Richardson, J. T. E., Slater, J. B., & Wilson, J. (2007). The National Student Survey:
542 Development, findings and implications. *Studies in Higher Education*, 32(5), 557–580.
543 <https://doi.org/10.1080/03075070701573757>
- 544 Robinson, W. S. (1950). Ecological correlations and the behavior of individuals. *American*
545 *Sociological Review*, 15(3), 351–357. <https://doi.org/10.2307/2087176>
- 546 Sabri, D. (2013). Student evaluations of teaching as “fact-totems”: The case of the UK
547 national student survey. *Sociological Research Online*, 18(4), 148–157.
548 <https://doi.org/10.5153/sro.3136>
- 549 Satterthwaite, J. D., & Vahid Roudsari, R. (2020). National Student Survey: Reliability and
550 prediction of overall satisfaction scores with special reference to UK Dental Schools.
551 *European Journal of Dental Education*, 24(2), 252–258.
552 <https://doi.org/10.1111/eje.12491>
- 553 Senior, C., Moores, E., & Burgess, A. P. (2017). “I Can’t Get No Satisfaction”: Measuring
554 Student Satisfaction in the Age of a Consumerist Higher Education. *Frontiers in*
555 *Psychology*, 8, 980. <https://doi.org/10.3389/fpsyg.2017.00980>
- 556 Simpson, E. H. (1951). The Interpretation of Interaction in Contingency Tables. *Journal of*
557 *the Royal Statistical Society. Series B (Methodological)*, 13(2), 238–241.

558 <https://doi.org/10.1038/168063d0>

559 Xu, R., & Wunsch, D. (2008). *Clustering*. New York, NY: John Wiley & Sons.

560 Yorke, M. (2009). “Student experience” surveys: Some methodological considerations and an
561 empirical investigation. *Assessment & Evaluation in Higher Education*, 34(6),
562 721–739. <https://doi.org/10.1080/02602930802474219>

Appendix
Appendix Table A1

Table A1

Questions of the NSS 2017 version (from HEFCE, 2016)

Number	Item
The teaching on my course	
1	Staff are good at explaining things
2	Staff have made the subject interesting
3	The course is intellectually stimulating
4	My course has challenged me to achieve my best work
Learning opportunities	
5	My course has provided me with opportunities to explore ideas or concepts in depth
6	My course has provided me with opportunities to bring information and ideas together from different topics
7	My course has provided me with opportunities to apply what I have learnt
Assessment and feedback	
8	The criteria used in marking have been clear in advance
9	Marking and assessment has been fair
10	Feedback on my work has been timely
11	I have received helpful comments on my work
Assessment and feedback	
12	I have been able to contact staff when I needed to
13	I have received sufficient advice and guidance in relation to my course
14	Good advice was available when I needed to make study choices on my course
Organisation and management	
15	The course is well organised and running smoothly
16	The timetable works efficiently for me
17	Any changes in the course or teaching have been communicated effectively
Organisation and management	
18	The IT resources and facilities provided have supported my learning well
19	The library resources (e.g. books, online services and learning spaces) have supported my learning well
20	I have been able to access course-specific resources (e.g. equipment, facilities, software, collections) when I needed to
Learning community	
21	I feel part of a community of staff and students
22	I have had the right opportunities to work with other students as part of my course
Student voice	
23	I have had the right opportunities to provide feedback on my course
24	Staff value students' views and opinions about the course
25	It is clear how students' feedback on the course has been acted on
26	The students' union (association or guild) effectively represents students' academic interests
General satisfaction	
27	Overall, I am satisfied with the quality of the course