Helping students to climb the mountain: a study to inform the development

2 ## of a resource to improve the learning of statistics in Psychology

3 **Abstract**

4 Students often struggle with learning about statistics, which encompass a large proportion of a

5 psychology degree. This pilot study explored how first- and final-year students reflected on their

6 experiences of being taught this topic, in order to identify needs that could be addressed in a project to

7 improve their learning.

8 First-year students reported that they initially found their module challenging but that it became easier

9 towards the end. Third year students recognised the importance of the topic but were not confident in

10 their abilities. Most students reported anxiety about statistics. Although students were positive about

11 practical classes, many felt that they could not easily remember the materials. The findings

12 suggested three areas of focus to improve student learning. Firstly, diverse needs and levels of ability

13 should be catered for. Secondly, students need help to go beyond surface learning and button

14 clicking. Finally, low levels of engagement should be addressed.

15 This work has informed a project to develop an online resource to address the above identified needs

16 to enhance teaching of this important topic.

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23 **Introduction**

24 *Background*

25 Psychology degrees in the UK are overseen by the British Psychological Society (BPS) and research

26 methods comprise 25% of the content. There is often a mismatch between student expectations about

27 psychology and the amount of statistics that they are required to learn (Ruggeri, Dempster, Hanna, &

28 Cleary, 2008). Evidence suggests that some students face difficulties, and sometimes even anxiety,

29 about this aspect of their studies (Onwuegbuzie, 2004). This anxiety is detrimental to the student

30 experience and often results in lower attainment on statistics modules (Onwuegbuzie & Wilson,

31 2003). Moreover, other evidence suggests that those who teach this topic perceive high levels of

32 student disengagement in statistics modules in psychology across the UK (Davies & Jackson, 2014).

33 Thus, those involved in teaching this topic may face a 'double challenge'; to reduce anxiety and

34 enhance engagement in lectures and seminars.

35 At ▮▮▮▮, in common with other UK institutions, there are lectures and practical seminars on

36 research methods and statistics in the first and second year of a Psychology undergraduate degree.

37 Lectures follow the traditional format of PowerPoint presentations, whereas in practical seminars,

38 students learn how to collect data, work on a computer to use the Statistical Package for the Social

39 Sciences (SPSS), and to learn to write lab reports. In the third year, students complete an independent

40 dissertation and are expected to apply their learning from previous parts of their degree programme.

41 An important feature of our degree programme is that it is modular, allowing students some flexibility

42 in their studies.

43 Although we often receive positive feedback in module evaluations in methods modules, we have

44 noted that in recent years, high levels of anxiety and low levels of confidence are demonstrated by our

45 students when reflecting on our teaching. Consequently, as a team, the authors sought to explore the

46 student experience of learning about statistics in psychology at our own institution in order to provide

47 information that would help us to develop further measures to support our students.

48   There is a wealth of existing research that explores the teaching of statistics in psychology (Chew &

49   Dillon, 2014; Field, 2014), which suggest methods by which it can be improved. For example, some

50   studies have proposed using humour to convey challenging topics (Lomax & Moosavi, 2002). Other

51   authors have suggested using a mix of strategies including ensuring lectures are interactive and

52   including real life examples (Neumann, Hood, & Neumann, 2008). What is clear from the literature

53   is that there is as yet, no widely agreed 'ideal' way in which to teach this topic. It is also evident from

54   our student feedback and our own reflections that our classes are made up of students of differing

55   statistical knowledge and engagement. Our starting point in this exploratory project was to select

56   students in the first and third years of study. First year students were of interest as they are at the start

57   of their journey into learning about statistics at university level; third year students were of interest as

58   they are putting their knowledge into practice to complete a dissertation

59   *First year students*

60   There is considerable evidence of a 'skill gap' between A-levels and university in a variety of

61   disciplines and the problems that it can cause to students' performance at university (Ballinger, 2003;

62   Gallager-Brett & Canning, 2011; Tate & Swords, 2013). For example, in a study by Tate and Swords

63   (2013) geography students identified that they were missing practical, cognitive and critical thinking

64   skills that impeded their progress at university level. In a recent review, Kitching and Hulme(2013)

65   discussed issues about transition from secondary education to university specifically related to

66   psychology. They concluded that there is indeed a considerable gap between pre-university education

67   and psychology at university, and that the students are not prepared well enough for university study.

68   A report by the Higher Education Academy (HEA) (Field, 2014) concluded that statistics anxiety and

69   lack of confidence in statistics are key factors that inhibit students' achievement and potential.

70   Moreover, the HEA report claims that around a fifth of all students are at risk of being left behind in

71   terms of statistical knowledge (Field, 2014). If psychology students were given help to bridge this

72   gap, then frustration regarding statistics may be reduced and academic performance enhanced.

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74   *Third year students*

75   At the other end of the scale, the culmination of a psychology degree is the completion of an

76   independent empirical project in the final year of undergraduate study, conducted under the

77   supervision of a single member of staff.   This requires students to put into practice what they have

78   learnt in their research methods and statistics modules in the first and second year of study.

79   Understanding students' experiences of applying what they have previously been taught offers an

80   opportunity for us to explore ways to enhance our teaching of this topic across the degree programme

81   and to attempt to reduce the anxiety that often accompanies these modules.

82   The aim of the current study was to understand the student experience of learning statistics in

83   psychology in years one and three.   Specifically we sought to: 1) explore first year students'

84   experiences of their methods module; 2) explore third year students' experiences of completing a

85   dissertation and 3) use those experiences to identify the needs to be addressed in a project to enhance

86   the teaching of this topic.

87   **Method**

88   *Participants and procedure*

89   All first-year psychology students registered for a required research methods module (n=140) were

90   invited to take part in two anonymous surveys via email at two time points in time. Seventy-six

91   (54%; 10 males, 66 females) first year psychology students took part in a survey at the beginning of

92   the module and 22 (16%) took part in a second survey at the end of the module (four males and 18

93   females).

94   All third-year students (n=87) registered for the project module were invited to take part in two

95   different anonymous surveys at two points in time. Thirty third year psychology students (34%; four

96   males, 26 females) took part in a survey prior to a 'refresher' class to help them analyse their data and

97   20 (23%; four males, 16 females) took part after submitting their dissertation

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99   *Measures*

100   The first and third year students completed different surveys in order to capture information relevant

101   to their current experience of studying.   The surveys were developed by the authors drawing on

102   insights from the literature and module feedback. The surveys consisted of questions relating to 1)

103   anxiety and confidence about statistics and 2) questions about the students' statistical knowledge. The

104   two surveys were administered to each year group of students.   For first year students this was at the

105   start and end of an introductory statistics module in order to explore changes in views about learning

106   statistics over time.   For the third year students this was before they began analysing their dissertation

107   data, prior to a SPSS refresher class, and once the dissertation had been submitted in order to explore

108   their views prior to and then upon completion of this important piece of work.   Each survey took

109   approximately 10-15 minutes to complete and was administered online using Qualtrics software.

110   *First year students*

111   In the two surveys directed at first year students, they were asked about their transition from pre-

112   tertiary to undergraduate level study, confidence levels, anxiety and experiences within the module.

113   There was a number of rating scale questions, for example 'How anxious do you feel about studying

114   statistics in this semester?'; these were rated from 1 (lowest level of anxiety) to 7 (highest level of

115   anxiety). There were also three open questions asking for further comment on experiences of learning

116   about this topic and the module.

117   *Third year students*

118   Before the SPSS refresher class, third year students were asked about their experiences of learning

119   SPSS and statistics and their feelings about preparing for the upcoming dissertation.   After

120   submission, they were asked about their experience of completing the dissertation and for overall

121   reflections on studying research methods during the degree.   There was a number of rating scale

122   questions, for example 'I feel confident about using SPSS for analysing my dissertation data'' rated

123   from 1 (scales from 1 (strongly disagree) to 7 (strongly agree).   There were three open questions

124   asking for further comment on experiences of learning about this topic.

125   The study received ethical approval from ███████Ethics Committee (project registration number

126   140798). Numerical questions were entered into SPSS and analysed using descriptive statistics. The

127   open answer questions were grouped into codes guided by the principles of thematic analysis (Braun

128   & Clarke, 2006) in order to search for themes relating to the experience of learning statistics.

129   **Results**

130   *First year students*

131   Table 1 shows the results from the two questionnaires for the rating questions. There is very little

132   evidence to suggest, at least from the quantitative data, that the module decreased their anxiety

133   (U=724.5, N=97, p=.376) for learning statistics. However, their confidence was significantly higher

134   for t-tests (U=522.5, N=97, p=.008), correlations (U=421, N=97, p<.001) and approaching

135   significance for chi-squared tests (U=565, N=95, p=.052) compared with their initial confidence about

136   studying statistics. This is in agreement with the qualitative results, whereby students said that

137   although they were less confident at the beginning and things improved towards the end of the

138   module. Regarding the question of how previous learning had equipped them for this module, the

139   average response was in the middle of the scale with very high variability, reflecting the large

140   differences in the background of the students. Students seemed to consider the 'practicals' more

141   useful than the lectures (T=4, N=15, p=.001).

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149   **Table 1:** *Response to survey questions by first year students studying a research methods modules.*
150   *All Likert scales 1-7, except where specified.*
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Feedback at First Seminar (N=76)	Median	Interquartile Range (IQR)
How confident do you feel about studying statistics this semester?	4	3-5
How anxious do you feel about studying statistics in this semester?	4	3-5
Confident about navigating through different windows in SPSS	5	4-6
Confident about opening and saving files in SPSS	6	4-7
Pace of this session (1=too slow, 10=too fast)	5	5-6

Feedback at Last Seminar (N=22)	Median	IQR
To what extent do you feel statistics you learned prior this degree equipped you for the current module?	4	2-5
Confidence with t-tests	5	4-6
Confidence with Correlations	5	4-6
Confidence with Chi square	5	4-6
Usefulness of the module	6	5-7
Overall difficulty of the module	5	3.75-5
Anxiety regarding the module	4	3-5
Number of lectures attended (10 in total)	9	8-10
Number of practicals attended (10 in total)	10	9-10
Usefulness of practicals	7	6-7
Usefulness of lectures	5	4-6

152   Note: First year students were only asked about t-tests, correlations and chi square as they were not
153   taught about other tests

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155   In the questionnaire administered at the beginning of the module, students were asked if they had been

156   taught statistics before; 33 (44%) replied that they had, and listed the statistical tests they could

157   remember.   Most of them mentioned having experience with non-parametric tests such as the

158   Wilcoxon's well as the Chi-squared test; 2students mentioned that there were familiar only with

159   descriptive statistics. Furthermore, two of the students had done A-levels maths, which may have an

160 impact on their confidence/ ability with statistics. Two students stated that they could not remember

161 if they did any statistics, while two students stated that they did learn statistics but they could not

162 remember which specific tests. These responses illustrate the variability of the background of the

163 students regarding statistical knowledge, with more than half of our sample having not done any

164 statistics at all in the past, which could be a benefit.

165 There were three open questions in the surveys completed by first year students ;only a small number

166 of the students completed these. Responses fell into three categories: *'positive', 'negative' and*

167 *'negative turned positive'.*

168 Positive comments were received about using the SPSS software, which was found to be, "*Intuitive*

169 *and easy to use all long".* Students were also positive about the level of support available – "*I feel*

170 *that the staff are approachable if I have a query or don't understand - thank you".*

171 Negative comments were around the difficulty of the module and the pace of classes. For some

172 students, the practical classes were too slow but for others they were far too fast – "*The practicals*

173 *took too long considering the simplicity of the content".*

174 There was also some evidence in the student comments that the experience of learning about statistics

175 was negative to begin with but positive by the end of the module – "*Started off hard but once I got it,*

176 *it became fun"; "I was unmotivated in the beginning as I thought it was going to be much harder than*

177 *it seem to be. I went from being terrified of stats to actually find it amusing now".*

178 Students were asked what they would like us to do to improve their experience of learning about

179 research methods and statistics.   Twelve students gave suggestions. Six students suggested an

180 introductory text to SPSS, in the form of a step-by-step guide. Students mentioned that it would have

181 been helpful to have access to such a resource before the module begun so that they were able to

182 prepare for it in their own time. However, one student felt that they did ok at the module and that

183 their mathematical background was sufficient and that an introduction to SPSS beforehand would

184 have been overwhelming. This contrast again illustrates the variability in the students' background

185 and preferences. Another student suggested that dummy data to practice with would be useful, while

186   another student suggested that having SPSS software at home from the beginning would have given

187   them the chance to practice at home beforehand (although they are able to access SPSS to use at home

188   via the library). Finally, another student stated that a brief overview explaining key ideas would have

189   been very useful at the beginning of the module.

190   *Third year students*

191   Table 2 shows student ratings of agreement to statements about their learning experiences. This table

192   shows a high level of anxiety or worry (Median = 6) together with a low level of confidence (Median

193   = 2) about the upcoming dissertation analysis. However, it does show that students were confident in

194   asking for help with this (Median 5.5). The level of agreement to the statement about enjoying

195   learning statistics was in the middle of the scale (Median 4.5). There was again a high level of

196   variability in response as indicated by the interquartile range for all questions..

197   Ratings of agreement to statements in table 2 show that practical classes were rated slightly higher on

198   enjoyment (T=8.5, N=9, p=.093) and lower on being avoided (T=0, N=5, p=.034) than lectures.

199   Enjoyment of lectures, time spent on statistics and worry before degree were both rated in the middle

200   of the scale, worry was rated higher during it. There was a low level of agreement to the statement

201   about the content of the degree and an above the middle of the scale rating to using statistics in a job

202   post degree. There was a lot of variability in the responses, other than to the statement about avoiding

203   practical classes.

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212 **Table 2**: *Response to survey questions by third year dissertation. All scales Likert scales 1-7.*
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Survey before a statistics refresher class *(N=30)*	Median	Interquartile Range (IQR)
I feel anxious or worried about having to use statistics in my dissertation	6	4-7
I have enjoyed learning about statistics during my degree	4.5	3-6
I feel confident about using SPSS for analysing my dissertation data	2	1-4
I feel confident in asking for help with my dissertation statistics if I need it	5.5	4-6
Survey following the dissertation *(N=20)*	**Median**	**IQR**
I expected my degree to have less statistics that I was taught	3	2-4
I found lectures on statistics to be enjoyable	4	3-5
I avoided lectures about statistics	2	1-3
I found practical classes to be enjoyable	5	3-6
I avoided practical classes about statistics	1	1-2
I wish there was more time spent learning statistics	4	3-7
I can see myself using statistics in future career	5	1-6
I felt anxious or worried about learning statistics before my degree	4	3-6
I felt anxious or worried about learning statistics during my degree	6	2-6

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215 There was a greater response to open questions from the third year students, than was seen in the first

216 year responses. The written comments made in response to open questions supported the variability

217 in the range of the rating questions. The responses of students prior to the refresher class were coded

218 *as positive* (10 comments)*, negative (26 comments), neutral (12 comments) and remembering (14*

219 *comments).*

220 Positive comments came from students who reported feeling confident in their ability to apply what

221 they had learnt to their dissertation – "*I like the fact that my dissertation is like pulling everything*

222 *together I have learnt over the past two and a half years into one big project that is completely my*

223 *own work"*. Students were also positive about the teaching team's support available to them in the

224 face of the challenging work ahead – *"There's no need to say that the stats team is brilliant. Thus I am*

225 *not worried at all regarding the pretty steep statistics mountain in front of me"*.

226 Negative comments were related to a low level of confidence. Students reported feeling worried

227 about their abilities, for example, when selecting the appropriate statistical test – *"I feel very bad*

228 *about SPSS, I often get the results section wrong in lab reports. I don't know what tests to use for*

229 *what and reporting them is difficult for me"*. For other students this was because they concerned about

230 making mistakes – *"I'm terrified that I'll do something wrong"*.

231 Some of the comments were coded as neutral because the students discussed general thoughts and

232 feelings about their dissertations or, for example, they felt that having a revision session would be

233 helpful but were not overly negative or positive – *"I did not have much issues using SPSS during the*

234 *past two years, but now I feel that my knowledge might need to be refreshed in all areas as it will help*

235 *with my dissertation"*.

236 However, many comments indicated that students had forgotten about the statistics they had learned

237 during their degree, so that they felt that they had an issue with *remembering* what they had to do – *"I*

238 *will be honest and say that I will not be able to remember much of what I have learnt from previous*

239 *years"*. This was reflected in comments that indicated students were really hopeful that the refresher

240 class would help them – *"I feel (I hope) that once we have this refresher session that my knowledge*

241 *about SPSS will come flooding back to me however, having not used the software for what feels like a*

242 *very long time, I am in a slight panic as to how to use it for my project"*

243 Following the submission of the dissertation responses were coded as *positive* (8comments), *negative*

244 (22 comments), *anxiety* (6 comments) and *suggestions* (19 comments).

245 Positive experiences about completing the dissertation related to improving confidence, the quality of

246 the seminars and the support received by demonstrators who taught them – *"F*un examples in the

247 *seminars were great, the demonstrators were really helpful"*.

248 The negative comments centred around 3 main sub-themes areas. The first were comments related to

249 the quality of the teaching in lectures – *"Lectures were poor, too quick and really complex"*.

250 Secondly, a number of comments referred to the teaching within the seminars, suggesting that

251 students had just learned to click the buttons in SPSS – *"I felt like I was just clicking buttons on the*

252 *screen rather doing statistical analyses, I could not understand why"; "It seems like all we learnt was*

253 *what order to press buttons on SPSS"*. Thirdly, the refresher session was not perceived to be useful

254 because of the time that it was held in the year and didn't cover materials as much detail as the

255 students wanted – *"The session was rushed and everyone's issues were individual, it was hard to ask*

256 *for help"*.

257 A number of the comments indicated the anxiety felt during the process of completing the dissertation

258 – *"I think everyone was really worried about the SPSS part of the dissertation"*.

259 Students were invited to make *suggestions* for improvements to the programme. These included

260 adding more statistics lectures to the final year, being taught to do statistical tests by hand, to less

261 specific suggestions of – *"Better online resources, more helpful lecture slides, better lecture times,*

262 *less repetition in lectures"*.

263 We also asked the third year students what advice they would give to new first year students. The

264 overwhelming response was to suggest they attended all lectures and seminars – *"Go to all the*

265 *lectures and seminars, it will only get harder if you start skipping them"; "Go to lectures AND*

266 *practicals, then you'll be fine!"*. This demonstrates that students do realise the importance of statistics

267 class attendance to their success in the degree programme. However, there is some recognition that

268 students may have pre-conceived ideas about this topic which may have adverse effects on learning

269 and attendance - *"Don't panic! People go in with the wrong attitude. Stats isn't that bad if you*

270 *approach it properly"*.

271 **Discussion**

272 The aim of this study was to explore the experiences of first and final year dissertation students with

273 regard to learning about statistics. The findings are discussed in light of the 3 questions:

274 *1) How do first year students reflect on their experience of learning about statistics in Psychology*

275 *before and after completing a first-year module in statistics?*

276 The quantitative questions showed that first year psychology students are not very anxious and are

277 fairly confident about statistics, although there was high degree of variability in the ratings. The

278 qualitative questions revealed that several students found statistics very difficult at the beginning but

279 became more confident, or found it easier with it towards the end of the module. On the other hand, a

280 small group of students continued to find statistics very challenging even at the end of the module,

281 whilst others did not experience any difficulties with statistics at any point. This variability in

282 knowledge, skills and confidence we observed is in sync with the findings of the HEA report (Field,

283 2014) and provides a challenge to address within classes. It is also important to note that only half of

284 the students had been taught statistics before university. Being given materials before the module

285 could help them prepare for it; for example, an introduction to SPSS and step-by-step guides, as well

286 as an overview of the module.

287 The results suggest that the transition from secondary education to first year of university in

288 psychology students learning statistics could be improved. A fair amount of students experience a

289 high level of anxiety, especially at the beginning of the module. This finding concurs with results

290 from previous studies (Ballinger, 2003; Gallager-Brett & Canning, 2011; Kitching & Hulme, 2013;

291 Tate & Swords, 2013). On the other hand, there were students that found the module easy and felt

292 they did not benefit from it (possibly those with prior experience of learning statistics). It appears that

293 the way statistics is taught in the first year of university does not fully address the needs of a

294 considerable amount of students and additional resources are needed to address this gap.

295 *2) How do third year students reflect on their experience of learning about and statistics in*

296 *Psychology during and after completing their dissertation?*

297 Unsurprisingly, students rated their confidence with tests and functions that they had learned in the

298 first year higher than those they had learned in subsequent years. However, it does indicate that there

299 is a need for further practice of the more complex tests and functions, such as ANOVA, regression

300 and factor analysis, which students at Oxford Brookes are more likely to use in their dissertation than

301 correlations or t-tests. Before completing the dissertation, students reported a high level of anxiety, as

302 well as low confidence in remembering which test to use, also supporting the need for further

303 practice. Post-dissertation, the findings also pointed towards high levels of anxiety about learning

304 statistics although it was promising to see that students had enjoyed the seminar classes and indicated

305 that they did not avoid these classes.

306 The open ended questions further highlighted the students' experiences of learning statistics. It

307 appeared that before the refresher class, students had forgotten much of what they had been taught

308 during the degree programme and had feelings of anxiety. Negative comments revealed that these

309 students had probably felt this way throughout the degree. On the other hand, it was positive to see

310 comments about how the dissertation pulled everything together. This is something that could

311 perhaps be highlighted more from the outset. Following the dissertation, student revealed their

312 feelings about teaching across the programme. Lectures were typically viewed in a less positive light

313 than seminar classes, possibly due to the interactive nature of the seminars. The findings also

314 indicated that students felt that some of the teaching involved 'spoon feeding' i.e. just clicking along

315 in SPSS without fully understanding what was happening. It was encouraging that students were able

316 to reflect on the benefits of the classes they had attended, demonstrated by their advice about

317 attendance to first years.

318 *3) How can we use the student experiences to draw up a list of needs to be addressed in a project to*

319 *enhance the teaching of this topic?*

320 It is interesting that whilst both first and third year students appeared to have a negative perception

321 about statistics at the start of the module or degree, this changed to a more positive attitude by the end.

322 This finding illustrates the need to counter the pre-conceived notion that statistics is something to be

323 feared and/or avoided. Indeed, the third year students revealed that their advice to newer students was

324 that attendance in both lectures and seminars was important. In order to increase attendance and

325 reduce some of the negativity, our findings suggest areas where we can focus to enhance the teaching

326 of statistics. Firstly, the variation in our students' knowledge indicates we need to address individual

327 student needs, providing extra support for those who are struggling, while allowing those who feel

328 more confident to continue to develop without feeling bored. There is a call for personalisation of

329 learning (Banyard, 2010) which is difficult to provide with the ever-increasing student numbers, but,

330 is important in addressing the needs of individual learners. Online resources appear to be an

331 important tool to promote personalisation of learning. For example, there is evidence that when

332 online resources take into account cognitive and learning styles, then students learn more effectively

333 compared to a control group that was taught in a more conventional way (Yang, Hwang, & Yang,

334 2013). Given that traditional university mass education typically adopts a narrow range of learning

335 and cognitive styles, it is no surprise that there is such variability in students' opinions and academic

336 performance. An online resource to accompany formal teaching that takes into account personal

337 cognitive, learning styles and knowledge level could be a step in the right direction to address the

338 individual needs of different students. This has the advantage of allowing students to work at their

339 own pace, without feeling pressure to keep up, or frustration if things are going too fast. Secondly,

340 there is a need to address the surface learning apparent in our students, so that they can apply their

341 skills and understand more than just which buttons to click; deeper learning needs to be encouraged.

342 Comments about 'button clicking' suggest that students may be taking a 'surface approach' to their

343 learning (Fry, Ketteridge, & Marshall, 2009).   Anxious students may not engage beyond surface

344 learning, especially if their underlying level of confidence with mathematics is low. However, the

345 comments we received in the survey indicated that these students may be feeling disempowered once

346 their reach the dissertation. We need to explore ways of encouraging a deeper approach to statistics

347 learning as this may reduce student anxiety around this topic. For example, by highlighting that

348 learning statistics is a journey towards the final dissertation from the outset.   Although this is

349 something that we currently do in seminars, it is possibly quite an abstract concept for those who have

350 just started university. Thirdly, we need to ensure that students can see the purpose of learning about

351 statistics from the start of their degree programme and to keep them engaged in the topic. In terms of

352 engagement, Banyard (2010) argues that teaching of psychology should become more exciting and

353 students should be allowed to explore interesting and 'relevant-to- them' psychological concepts,

354 rather than just learning analysis techniques and 'impeccable trivia'. This may lead to a greater ability

355 to apply what is learned to topics that are of interest to students, as well as prepare them for the

356 workplace. Also, studying tends to focus on assessment; we 'teach to test' instead of helping our

357 students become independent and creative thinkers. Other studies have shown that using a more

358 informal and conversational style (Ginns & Fraser, 2010) and using humour while teaching (Garner,

359 2006) improves students' learning. In a similar vein, Rahman and Zeglin (2014) provided some

360 preliminary evidence that using comic books can enhance teaching of abnormal psychology.

361 Additional, fun materials to aid the students' learning could be beneficial to those who are struggling.

362 Furthermore, computer games can be used to help students practice with statistics in a more enjoyable

363 way (Morris, 2013). It seems possible that students will be engaged and interested if given the

364 opportunity to create the materials and mentoring other students, rather than just be passive receivers

365 of education.

366 There are two additional challenges to be faced as revealed in our findings. Firstly, how to help

367 students adapt to university study and secondly how to ensure they retain the information learned

368 during the three year degree programme in order to apply it during their dissertation. The research

369 discussed in the introduction to this paper and our findings show that there is a challenge to be

370 addressed in bridging gap between pre-tertiary education and university. Kitching and Hulme (2013)

371 indicate that A-level Psychology should encourage more critical thinking and problem solving, rather

372 than learning by rote. They also suggest that induction procedures should become more effective to

373 make sure students are given a good introduction to university study. Also, study and writing skills

374 training could be included in the first year of a degree. Banyard (2008) suggests making it

375 compulsory for students to do A-level psychology if they wish to study psychology at university, to

376 make sure that there is less variability in level of knowledge between students but this change is

377 unlikely to happen in the near future. Finally, a HEA report (2014), suggests using diagnostic tests

378 for new students, along with follow-up actions to make sure that the students are progressing well

379 (Field, 2014). An online resource that includes diagnostic tests as well as materials for students to

380 practice before they start university could also bridge the gap to an extent. Prospective students could

381   be given access to these resources to study over the summer, before they start their first year at

382   university. In order to build such a resource, it will be important to work with students and applicants

383   to the university so that it meets their needs and does not appear overwhelming or off-putting.

384   Furthermore, we need to ensure that students retain the knowledge they acquired in their first and

385   second years of university so that they can apply it when they work on their own project in the third

386   year. There is therefore a need to integrate the statistics teaching across our programme. One way of

387   achieving this is to develop an overarching resource that could allow the whole programme to be

388   more 'constructively aligned' towards the dissertation (Biggs, 1996). This may also enable the

389   fostering of a 'research community', which allows students to see their learning of statistics in light of

390   its contribution to their development as independent researchers. A feature of this community could

391   be to get undergraduates even more involved in staff research as has been successful at other

392   institutions (Roberts, Ertubey, McMurray, & Robertson, 2010). Without our modular system, a

393   research community could be built online, and involve the creation of a 'one stop shop' for statistics

394   rather than have different tests attached to specific modules or years. Coupled with increased

395   opportunity to partner with staff in research, this may enable students to see the importance of what

396   they are learning for their future dissertation projects. This method could additionally enable

397   interaction between students in different years, and as demonstrated in the advice comments above, it

398   might be beneficial for first year students to hear. Peer-assisted learning has been tried successfully in

399   Psychology with third years assigned specifically to first years as learning mentors (Stone, Meade, &

400   Watling, 2012). Kitching and Hulme (2013) also propose peer assisted learning as a method of

401   improving transitions.

402   *Limitations*

403   The survey questions posed to the first and third year students were not the same and this limits

404   comparisons between the two year groups, although direct comparisons were not the focus of this

405   study. A greater proportion of the first year students completed the questionnaires compared to the

406   third years. Equally we are not able to identify if the same students completed the surveys at both

407 time points in order to see if their levels of confidence or anxiety had changed. This was a small

408 study in one setting and so the findings must be interpreted with caution. The sample size post-

409 dissertation was particularly small, reflecting that students may have left or were less motivated to

410 engage with something that would not directly be of benefit to them. Moreover, it is likely that those

411 who felt most strongly were more likely to respond. Although it is important to take these limitations

412 into account, these responses are important in telling us about student experiences of learning about

413 statistics and research methods within our degree programme and can help us to make improvements

414 in our teaching.

415 *Conclusions*

416 Although there is a wealth of existing research into statistics anxiety, there is still a need to identify

417 the means by which educators can improve the learning of this important topic. While this is a small

418 study in one setting, this work has identified a number of needs that should be addressed in the

419 development of a project to improve the teaching of statistics in psychology in our institution. The

420 important needs are: 1) to address the needs of students with different levels of ability and knowledge;

421 2) to help students achieve more than a surface understanding of data analysis and; 3) to increase

422 engagement and interest.

423 *We used the findings of this study to inform an application for ▮▮▮▮ Team Teaching Fellowship*

424 *Project, and were successful in receiving funding for our project through a competitive bidding*

425 *process. Future work will now be undertaken to address the identified needs through the creation of*

426 *an open online resource that incorporates additional materials that link them together to demonstrate*

427 *their application as research skills. Our overall aim for this resource is to create a research*

428 *community, which fosters vertical collaboration and support between students.*

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