



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

Student engagement and perceptions of blended-learning of a clinical module in a veterinary degree program.

Citation for published version:

Kelly, R, Mihm-Carmichael, M & Hammond, JA 2019, 'Student engagement and perceptions of blended-learning of a clinical module in a veterinary degree program.', *Journal of Veterinary Medical Education*.
<https://doi.org/10.3138/jvme.2019-0018>

Digital Object Identifier (DOI):

[10.3138/jvme.2019-0018](https://doi.org/10.3138/jvme.2019-0018)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

Journal of Veterinary Medical Education

General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.



1 **Title**

2 *Student engagement and perceptions of blended-learning of a*
3 *clinical module in a veterinary degree program.*

4
5 R. F. Kelly¹, M. Mihm-Carmichael², J. A. Hammond³

6
7 ¹Farm Animal Services, Royal (Dick) School of Veterinary Studies, University of
8 Edinburgh, Easter Bush, Roslin, Midlothian EH25 9RG, UK.

9 ²Farm Animal Clinical Sciences, School of Veterinary Medicine, University of
10 Glasgow, Glasgow, G61 1QH, UK.

11 ³Veterinary Science & Education, School of Veterinary Medicine, University of
12 Glasgow, Glasgow, G61 1QH, UK.

13
14 **Keywords**

15 Blended learning; Veterinary education; eLearning; Farm Animal; Clinical;
16 Multimedia; Videos; Student perceptions; Case-based learning; Student
17 engagement.

18
19 **Abstract (250/250 words max)**

20 Blended learning has received much interest in higher education as a way to
21 increase learning efficiency and effectiveness. By combining face-to-face teaching
22 with technology-enhanced learning through online resources, students can
23 manage their own learning. Blended methods are of particular interest in
24 professional degrees such as veterinary medicine where students need the
25 flexibility to undertake intra and extra-mural activities in order to develop the
26 range of competencies required to achieve a professional qualification. Yet it is
27 unclear how veterinary students engage with blended learning activities and
28 whether they perceive the approach as beneficial.

29
30 This article evaluates blended learning through review of student feedback from
31 a 4-week-clinical module in a veterinary degree programme. The module
32 combined face-to-face sessions with online resources. Feedback was collected
33 using a structured-online questionnaire at the end of the module and log data
34 collected as part of a routine teaching audit. The features of blended learning
35 that support and detract from the student learning experience were explored
36 using quantitative and qualitative methods.

37
38 Students perceived a benefit from aspects of the face-to-face teaching and
39 technology-enhanced learning resources. Face-to-face teaching was appreciated
40 for practical activities whereas online resources were considered effective for
41 facilitating module organisation and allowing flexible access to learning
42 materials. The blended approach was particularly appreciated for clinical skills
43 where students valued a combination of visual resources and practical activities.
44 Although this study identified several limitations with online resources, which
45 need to be addressed when constructing blended courses, blended learning
46 shows potential in clinical courses to enhance student-led learning.

48

49 **Introduction**

50 Professional degree courses require a balance of workplace learning
51 opportunities with academic elements of the curriculum (1,2). Like other
52 undergraduate students, those studying for professional degrees have to fit their
53 study around other life commitments, which can complicate and disrupt
54 timetabling academic and workplace commitments (3–5). For example, in the UK
55 professional training of veterinary surgeons is knowledge intensive, applied and
56 focused on omni-competence (6). Historically this has led to heavy lecture
57 schedules and significant contact time with veterinary educators to enable
58 students to attain the competencies required to register as a veterinary surgeon
59 (7). Students are also obliged to complete work experience in clinical practice,
60 undertaken in addition to their academic studies, to develop clinical and
61 workplace skills. Furthermore, as contemporary veterinary practice is becoming
62 more specialised (8), the scope of knowledge expected of veterinary graduates is
63 increasing further, despite the program length remaining the same. Thus, the
64 challenge for today’s veterinary educators is to prepare graduates to enter the
65 workplace with the applicable skills set and knowledge to “hit the ground
66 running” by helping them to be time efficient and lifelong learners (9).

67 In response to student study and life commitments, many higher education (HE)
68 courses are adopting student-centred learning approaches to their teaching
69 (10,11). The aim is to allow students to choose when, where and how they learn
70 course content (10). “Blended learning” (BL) is one of the student-centred
71 learning approaches being adopted by HE institutions. When designing new
72 blended courses, educators aim to balance the use of face-to-face (F2F) with
73 technology-enhanced learning (TEL) resources to meet these personal needs of
74 the learner (12). Technology-enhanced learning resources are often used to
75 replace some of the F2F aspects of the course yet it is integral that all resources
76 still align to course intended learning objectives (ILOs) (13). Increased interest
77 in the TEL aspect of BL is set to continue for students who are increasingly able
78 to choose their mode, pace and place of learning (14), and for organisation of
79 course content. Blended learning techniques may be well suited to veterinary
80 medicine training to balance academic and workplace learning commitments.
81 Blended learning techniques may also encourage independent lifelong learning
82 that is vital to the contemporary veterinary surgeon within their profession
83 (9,15). Although extensive research has been conducted in medical schools (16–
84 19), it is unknown whether BL methods are perceived as beneficial to student
85 learning in the context of veterinary education. A main theme from medical
86 experience is that BL methods are positively perceived by students, but only if
87 courses are designed to benefit their learning rather than being a replacement
88 for staff F2F teaching time (16).

89 Deep learning involves stepwise construction and application of knowledge to
90 promote critical thinking in order to embed learning content (20,21). Developing
91 skills in critical thinking and problem solving are vital to the clinical ability of a
92 veterinary surgeon, requiring development throughout undergraduate studies
93 and beyond (22,23). Using multimodal learning methods to teach students can
94 encourage development of critical thinking and problem solving skills (24,25).

95 The overuse of TEL over F2F methods can lead to student disengagement and
96 promote superficial learning rather than deep learning practices (26). As the
97 quality of student learning could be influenced by the balance of F2F and TEL
98 activities within a BL course, it is important to assess student engagement with
99 these activities.

100 This paper explores student perceptions and engagement with a novel blended-
101 learning module within a clinical component of a UK five year undergraduate
102 veterinary degree program. Specifically we aimed to establish how students
103 engage with different elements of TEL and F2F activities, including access times
104 and patterns to online resources. We also evaluated the range of student
105 perception of blended learning elements, including workload and relevance of
106 TEL and F2F resources.

107

108 **Materials and methods**

109 *Context*

110 Since 2013, the Glasgow University School of Veterinary Medicine (GU-SVM)
111 Bachelor in Veterinary Medicine and Surgery (BVMS) degree program has
112 undergone a major curriculum restructure with a focus on ensuring the
113 competency and employability of graduating veterinary surgeons. The
114 restructure was more broadly supported by Glasgow University's "E-Learning
115 Strategy 2013-2020" (27) with inclusion of BL principles. Specifically, the new
116 degree program structure champions student-centred learning by encouraging
117 independence, choice and flexibility in the individual students' learning
118 experience. The new BVMS degree was split into foundation (Years 1-2) and
119 clinical (Years 3-4) phases in order to prepare students for the supervised
120 workplace based final year, or professional phase (Year 5). Both the foundation
121 and clinical phases utilised BL via fewer lectures, more practical classes and
122 small group case-based learning (CBL) sessions (28). Case-based sessions were
123 facilitated F2F, complemented through online activities using the University's
124 virtual learning environment (VLE). The new permutation of the BVMS program
125 integrates scientific and clinical disciplines throughout the degree, aiming to
126 promote better application of core knowledge through independent learning.

127

128 The first implementation of the two year clinical phase started in 2015-16, with
129 the third year considered as a course incorporating six four week long modules
130 and one two week long module (Figure 1). As part of the third-year clinical
131 phase, a new four week module integrated four core clinical farm animal
132 disciplines. These disciplines included 1. Clinical ruminant medicine and surgery
133 2. Ruminant parasitology 3. Population medicine/ epidemiology and 4.
134 Pharmacology. The structure of the module was organised through the UG-SVM
135 VLE (Moodle®), where students could access resources at any time of the day.
136 Primarily the module was made up of F2F and TEL activities (Supplementary
137 material 1). For TEL resources, students had availability from day 1 of the
138 module Some of the TEL activities were hosted on another VLE platform
139 (Mahara®) linked to the UG-SVM VLE. Students were guided through the module
140 by being given access to different activities in each of the 4 weeks via the UG-

141 SVM VLE (Figure 2). To encourage learners to apply the knowledge taught across
142 these disciplines, online TEL resources were designed to complement F2F
143 sessions as self-directed tasks (Figure 2). The self-directed TEL resources fitted
144 into four core clinical farm animal disciplines (Supplementary material 1).
145 Nominal timetable slots were allocated for TEL activities, although it was stated
146 on the VLE that students could choose when to engage with TEL activities. All the
147 TEL resources were designed in consultation with other members of the Farm
148 Animal Clinical Sciences Division.

149 Compared to other modules in the Clinical phase, this module extended and
150 formalised the use of BL approaches, for example through additional use of TEL
151 activities, such as online CBL activities. In addition, there was an emphasis on
152 designing complementary use of TEL activities to enhance the benefit of F2F
153 sessions, such as online clinical examination videos provided before a practical
154 clinical examination class.

155

156 *Study design and data collection*

157 To assess student engagement and perceptions of blended learning, we sampled
158 students who were enrolled in the first cycle of the module (January and
159 February 2016).

160 To assess student engagement in the module, attendance at F2F teaching
161 sessions was recorded by class registers. To evaluate the access and use of the
162 online TEL activities for the module; log data were accessed for each TEL activity
163 within the module through UG-SVM VLE and exported as CSV files for further
164 analysis. Each student access event was defined as the student either starting or
165 downloading the TEL resource, depending on the nature of the resource. For
166 example, a download of a lecture and accessing a quiz from the start were each
167 classified as a singular access. Class attendance and log data was collected for all
168 students enrolled in the module. Data was recorded for 6 weeks, 4 weeks of the
169 module and 2 weeks leading up to submission of the summative assessment was
170 collected from all students enrolled in the module.

171 To assess student perception of the module, we used student feedback collected
172 as part of routine teaching evaluation and audit. Specifically, student feedback on
173 the module were collected via a structured-online questionnaire. All students
174 enrolled in the module had access to the questionnaire from the middle of the
175 fourth week of the module. An email sent to request students completed the
176 feedback questionnaire, although feedback was voluntary and did not influence
177 academic progression. An email was sent to request students to complete
178 feedback. Students were also reminded in a lecture on the last day of the module.
179 It was assumed that students were familiar with using the UG-SVM VLE feedback
180 tool, as similar methods have been used in previous modules in the Foundation
181 Phase (Years 1 & 2) of the BVMS degree. The questionnaire was created using a
182 survey tool within the UG-SVM VLE (Supplementary material 2). Questions were
183 split into three sections: 1. Quality of module content related to the module
184 Intended Learning Outcomes (ILOs), 2. F2F teaching practices and 3. TEL
185 resources. Questions were predominantly in the form of statements that invited

186 students to choose their level of agreement with the statement. Options were
187 based on a 5-point Likert scale of “Strongly agree” (SA), “Agree” (A), “Neutral”
188 (N), “Disagree” (D) and “Strongly disagree” (SD) (29). Additional free text
189 questions were added to allow further elaboration on certain aspects of the
190 questionnaire particularly concerning TEL resources.

191

192 *Data analysis*

193 Both qualitative and quantitative data were anonymised prior to analysis.
194 Quantitative data collected from the questionnaire (including Likert scale
195 responses) and UG-SVM VLE logs were analysed using simple summary statistics
196 (Median and proportions) and descriptive graphs in Microsoft® Excel.

197

198 Qualitative data collected through the questionnaire were analysed by the lead
199 author (RK) employing a simple thematic analysis using an inductive approach
200 (30,31). Two researchers were involved in this process. The lead author (RK)
201 was the organiser of the module and has a background in farm animal practice.
202 The second author (JH) is not directly involved with the module, but has an
203 understanding of the curriculum as leader of the final year of the BVMS
204 Programme with a background in small animal practice and veterinary
205 education.

206

207 Firstly, qualitative questionnaire data was exported as a Microsoft Excel®
208 spreadsheet. All questionnaire statements were read and re-read to develop a
209 preliminary coding structure. Then the lead author coded all statements to each
210 of the preliminary codes and grouped related codes to form subthemes using
211 colour coding within the spreadsheet. Each response may have had more than
212 one subtheme attributed to it. Once completed, the subthemes were organised
213 into major themes using a second colour code. A second author (JH) reviewed
214 the initial coding approach and both authors discussed areas of difference,
215 agreeing a final coding structure and allocation of comments to codes, related
216 codes to subthemes, and subthemes to themes. Although the aim of the exercise
217 was to represent rather than quantify the range of perceptions captured in the
218 free-text comments, the number of statements associated with each theme and
219 subtheme is reported to illustrate that the themes identified are characteristic of
220 this set of individuals and to illustrate the diversity of perceptions in the group
221 studied(32).

222

223 *Ethics*

224 The teaching evaluation was conducted at GU-SVM (part of the College of
225 Medical, Veterinary and Life Sciences (MVLS) at the University of Glasgow).
226 Ethical approval for retrospective analysis of routinely collected data has been
227 granted under MVLS VLE research guidance and the GU-SVM privacy notice
228 published on the Vet School General Resource read by all students, and projects
229 are under the oversight of a School Data Custodian to ensure appropriate use
230 under the General Data Protection Regulation. In addition, ethical approval for
231 the evaluation of blended and online learning developments was granted by the
232 MVLS Research Ethics committee under license number 200160080.

233

234 **Results**

235 *Student engagement*

236 In January 2016, 123 students were enrolled in the first cycle of the module.
237 Students had individual timetables for all F2F sessions and 100% of students
238 attended.

239

240 The proportion of students accessing each type of TEL resource was recorded
241 over the duration of the module and for 2 weeks after (Figure 3). All 123
242 students downloaded lecture material and small group teaching (CBL and
243 practical class) guidance. A majority of students accessed clinical examination
244 videos (95.9%), the parasitology textbook (85.4%), farm calendars (72.4%),
245 pharmaceutical online CBL (69.9%) and the end of module quiz (64.2%). Less
246 than half of the students chose to provide end of module feedback (44.7%).
247 There were differences in how often students accessed each type of TEL
248 resource (Figure 4). Most students accessed practical/ CBL guidance, clinical
249 examination videos and parasitology textbooks 2-5 times or less. Lecture
250 material was accessed 6-10 times and the end of module quiz between 21-50
251 times by the majority of students. The frequency of access to the pharmaceutical
252 online CBL varied much more between students than other TEL resources, with a
253 much wider range of frequency of access. Looking at the time of day when TEL
254 resources were accessed (Figure 5), few students accessed any TEL resources
255 between 0.00-07.00. Lecture material was mainly accessed between 07.00-13.00,
256 whereas most other resources were accessed during the afternoon and evening
257 (13.00-18.00 and 18.00-00.00).

258

259 All 123 students undertook the group end of module summative assessment .
260 Students worked in groups of 4-5 students, with a submission deadline 2 weeks
261 after the end of module teaching. A group mark was given to individual students
262 within each group using a grading rubric. Subsequently, all students achieved a
263 passing standard grade in the summative assessment.

264

265 **Student feedback**

266 *Questionnaire statements*

267 The response rate for the feedback questionnaire was 44.7%, which represents
268 less than half of the students enrolled on the module (Supplementary material
269 2). Student statements to questionnaire statements are summarised in table 1.
270 Overall, students were satisfied with the module and agreed that it was made
271 clear what they were expected to learn. Most students agreed or strongly agreed
272 that module content was pitched at the right level and the workload manageable.

273 In respect to F2F teaching (Table 1), students agreed that lecturers made
274 teaching material interesting and provided useful feedback. Over half of
275 respondents agreed that group classes and assessment enabled them to work as
276 a team, with less than 10% disagreeing. For TEL resources, most students agreed
277 or strongly agreed that online content was well organised, relevant and easy to
278 navigate. Online communication was appreciated, instructions clear and online
279 support adequate. Half of students agreed that the online calendars and

280 parasitology textbook were useful. However, the majority of students disagreed
281 that the pharmaceutical online CBL was useful, with the remainder neutral to
282 this activity. Three quarters of students found the formative module assessment
283 interesting and expressed that it brought together module content, with the
284 remainder of students being neutral to the assessment.

285

286 *Free text statements*

287 The majority of students who undertook the questionnaire, responded to some
288 of the free-text questions with a total of 195 free-text statements
289 (Supplementary material 2). Three major themes were identified relating to
290 student perceptions of blended learning in the statements to the free text
291 questions: "Balance of F2F and TEL resources", "Module design and delivery" and
292 "Participant factors". Table 2 summarises the number of statements coded to
293 major and sub-theme.

294

295 Balance of face to face and technology enhanced learning activities

296 Of the free-text statements, 93 related to balance of F2F and TEL activities within
297 the module. These statements split into two sub-themes: "Synergistic resources"
298 and "Student-lecturer interaction".

299

300 Synergistic resources:

301 Many statements were positive about the mix of F2F and TEL activities (55
302 statements) within the module. For F2F activities, statements related to
303 appreciation of practical classes and CBL seminars (13/55), complimenting
304 lectures which were pitched at the right level (4/55). A number of students
305 explained they enjoyed these sessions that were complimented by TEL resources
306 as they provided an opportunity to apply theoretical knowledge into a practical
307 setting:

308

309 *Student 39: " "It (RE: Online farm calendars) made me review a lot of*
310 *diseases/procedures and think about when in the year they occur. It was very*
311 *useful to then be given the completed calendar (after the lectures) so that I could*
312 *begin to build a better idea of when in the farming year certain things occur."*

313

314 Students expressed their positive impression of TEL activities, mainly
315 commenting on online CBL activities. Similarly, students felt that the
316 pharmaceutical prescription activity assisted applying theory into practice
317 (15/55 statements). For other online CBL activities, such as the farm calendar
318 and parasitology textbook, students felt they were mainly useful for revision by
319 consolidating learning (19/55 statements). For parasitology teaching in
320 particular, students commented that online materials supported F2F practical
321 class teaching (8/55 statements):

322

323 *Student 29: "You wouldn't understand what you're doing in the parasitology*
324 *practical without these resources they are very good."*

325

326 Nonetheless, students expressed that TEL activities should not be used to replace
327 F2F teaching activities (3/55). This was particularly relevant for clinical skill

328 teaching, where students felt that the physical aspects of activities could not be
329 mimicked online:

330

331 *Student 12: "I feel like sometimes for the clinical skills practicals they expect you to*
332 *have already learnt everything on the videos before you arrive. The videos should*
333 *be an aid to assist your learning and prepare for the class but not a substitute for in*
334 *class teaching."*

335

336 Student-lecturer interaction:

337 A small number of students (18) commented on student-lecturer interaction. For
338 F2F sessions, including lectures and practical sessions, most commented that
339 content was pitched at the right level. Such statements praised staff interaction
340 with them highlighting that the interaction assisted in applying the lecture
341 content to real-life scenarios (7/18) such as in CBL tutorials:

342

343 *Student 27: "Enjoyed the CBLs case scenario discussion as they help me identify*
344 *where in my thoughts process did I went (sic) wrong or have done correctly, and*
345 *eventually guides me to the final diagnosis. Which I felt is really useful"*

346

347 In contrast, three students expressed that similar interaction was lacking from
348 online CBL sessions. For example, 6 students felt that they lacked guidance for
349 the farm calendar or pharmaceutical prescription online CBLs. Other statements
350 suggested that students felt that they missed out on the opportunity to discuss
351 released answers, which would have helped them prioritise topics for further
352 study.

353

354 Module design and delivery factors

355 In total 67 statements related to module design and delivery. These statements
356 were divided into three sub-themes: "Module content organization", "Time
357 management and allocation" and "Software limitations".

358

359 Module content organization:

360 This theme included both positive and negative comments. The majority of
361 negative comments related to module factors that affected students managing
362 their own learning time (23/67). For example, a small number of participants
363 (12/23) were frustrated that not all module content was hosted on the VLE and
364 found it difficult to locate these resources:

365

366 *Student 15 (Re: Parasitology textbook): "I was not even aware of this. There's a*
367 *whole lot of information scattered in a lot of different places, which makes it really*
368 *hard to keep track of it all, as well as prioritize."*

369

370 Other negative comments related to late provision of both TEL and F2F teaching.
371 Nine participants reported that some staff arrived late to give lectures and that
372 sometimes lecture materials were uploaded to the VLE after lectures were given.
373 Student's perception were that tardiness made it difficult to prioritise content in
374 their study time. Also, a number of these comments (3/9) expressed dislike of
375 last-minute changes to lecture materials:

376

377 *Student 47: "There were several occasions throughout this module where lectures*
378 *had been posted to moodle, but then changed without any notice to students. This is*
379 *particularly frustrating when students print these lectures out or review them*
380 *beforehand..."*

381

382 Specifically, only two respondents commented on appreciating the organisation
383 of online TEL content into folders making content easy to navigate content on
384 the VLE.

385

386 Time management and allocation:

387 Over half of statements related to module design were related to time
388 management and allocation of module activities (43/67). The majority of
389 comments related to TEL activities taking longer than expected, specifically the
390 farm animal calendar and the group summative assessment. A common
391 explanation was that researching for such activities from content elsewhere in
392 the module was too time consuming for the time available to study. Although
393 respondents (6/43) did appreciate the learning experience after the activity was
394 completed:

395

396 *Student 24 (Re: Farm animal calendar online CBL activity): "(It was) difficult to*
397 *find the information so it took a long time to find anything relevant, but useful*
398 *when done."*

399

400 Despite the extended length of some sessions, only one student negatively
401 commented that F2F activities overran allocated time slots. A number of
402 statements (6/43) commented that to some TEL resources, such as the
403 parasitology textbook and online pre-reading material, were too extensive
404 making it difficult to prioritise what to study in the time allocated. Yet a similar
405 number of statements (5/43) praised the extent of these resources, providing
406 the opportunity for students to study topics more in depth than taught material.

407

408 Software limitations:

409 Nine students commented on the limitations of the software used to design TEL
410 activities, mostly relating to the pharmaceutical prescription online CBL activity.
411 It was highlighted that even if students got the answer right, but their free-text
412 answer was phrased differently to the automated answer, the software marked
413 the answer as incorrect (Figure 6) resulting in much lower global marks in this
414 activity than individual students expected. This student describes the negative
415 impact on learning of these software limitations:

416

417 *Student 02 (Re: Pharmaceutical prescription online CBL activity): "Many things*
418 *were marked as incorrect but the correct answers were not given, so cannot review*
419 *it and learn from mistakes."*

420

421 Yet students also expressed that the activity was useful in developing prescribing
422 habits. Two students suggested that a potential solution to the software marking
423 limitations would be producing example answers at the end of activity rather
424 than the software marking individual answers. These comments highlight the
425 perceived benefit of the activity, despite the software marking limitations.

426

427 Participant factors

428 Of all free-text statements, 43 related to individual participant factors that
429 influenced perception of, and engagement with, module content. Twenty nine
430 student statements described how engagement in activities was affected by their
431 previous knowledge of module subjects. Respondents who identified as having
432 insufficient background knowledge (ruminant livestock and agriculture), felt
433 that TEL activities were difficult and time consuming to partake in (9/29). This
434 was exemplified in the farm calendar activity:

435

436 *Student 14: "With no background knowledge in livestock farming, I don't know*
437 *where to start."*

438

439 Students also mentioned that some of the module overlapped with content
440 elsewhere in the veterinary degree program. While some perceived too much
441 overlap (3/29), others took overlap as positive (14/29). Overlap seemingly
442 helped students to integrate module content with assumed background
443 knowledge (livestock and agriculture):

444

445 *Student 6: "Useful to be able to work through a calendar and link up the times of*
446 *the year to management procedures and diseases to look out for."*

447

448 Students mentioned that various F2F and TEL activities were relevant to their
449 future career choices (10/43). Responders who specifically intended to go into a
450 career related to the module content, enjoyed engaging with TEL content within
451 the module (3/43):

452

453 *Student 45: "Really fun module - has made me consider going into mixed (species*
454 *clinical) practice."*

455

456 **Discussion**

457

458 Blending learning practices are proposed to encourage students to manage their
459 own learning, around other commitments, whilst still meeting the learning
460 outcomes of a course (12). As a student-centred approach, BL could be useful for
461 professional veterinary degree programmes to support students to balance
462 academic, workplace and personal commitments. The fact that students in this
463 study accessed TEL resources outside of traditional working hours supports this
464 idea. The majority of students engaged with course material, with various TEL
465 activities accessed throughout the day depending on the activity. Blended
466 learning can also encourage students post-graduation to learn independently,
467 which is an important attribute to continued professional development (33).
468 Assessing student engagement and perception of courses can provide an insight
469 into the experience of BL, its impact on learning and highlight areas to consider
470 when designing courses using BL. Although there are well-documented
471 limitations in questionnaire-based student feedback studies (34), this study
472 provided insights into student perceptions on BL. Aspects of F2F and TEL
473 activities were well received by students, particularly activities that integrated
474 and applied course topics. Interaction between students and teachers was also

475 highly valued. In the wider context, student feedback highlighted a number of BL
476 factors that affected the learning experience of students and should be
477 considered when developing courses based on BL principles.

478

479 In our study, we investigated student engagement with F2F and TEL activities.
480 F2F and TEL activities were nominally timetabled in “working hours” (9.00-
481 17.00 hours Monday to Friday), although TEL activities could be completed in
482 their free time, within or out of working hours, if individual students wished. The
483 majority of TEL activities were accessed during working hours, with the trend of
484 lecture material being accessed in the mornings when lectures were timetabled
485 and complementary activities being accessed in the afternoon or evening.
486 Flexibility in students planning their study time is widely seen as a positive step
487 within HE, to allow them to direct their learning to what is most effective for
488 individuals when and wherever it suits them (35,36). It is therefore unsurprising
489 that in our study, individual students managed their time differently and there
490 are likely various reasons for different study strategies. Although we did collect
491 data on individual student study patterns and what factors drives them to
492 manage their own study time, students did not highlight whether they were
493 accessing TEL activities around life commitments. A study by Holley and Dobson
494 looked at a cohort of >1000 undergraduate students undertaking a BL course
495 and their access to online TEL activities over the duration of the course (37).
496 Students particularly accessed TEL activities over weekends to manage their
497 learning around part-time jobs and to work at their own pace. However,
498 veterinary and other professional degree students have additional course related
499 commitments on their time, which potentially restricts their time for other life
500 commitments (38). As BL courses potentially could have negative effects on
501 student work-life balance, the amount of time spent on non-timetabled activities
502 and students’ ability to utilise this time, has to be considered when designing BL
503 courses. It is recommended that the amount of time taken to complete course
504 activities, within and outside the academic timetable, should be audited to make
505 sure that students can manage their time with other commitments (13). For the
506 UK veterinary profession in particular, increasing mental health problems have
507 been associated with problems relating to work-life balance (39). Work overload
508 can impact on academic performance, satisfaction and mental health (40,41).
509 Students should be empowered to develop the skills to manage their study, work
510 and life commitments from the early stages of their degree. Although time was
511 allocated to complete TEL activities, the amount of time to complete specific
512 activities was not recommended. In hindsight, this may have led to students
513 spending inappropriate amounts of time on individual activities. “Sign-posting”
514 recommended time to complete a TEL activity, may assist students in time
515 allocation and assist promoting a healthy work-life balance. This is particularly
516 important given our observation that a number of students commented that
517 activities took longer than they expected. There is also an onus on Veterinary
518 Schools to ensure that expectations of student workload are reasonable and
519 clear to applicants.

520

521 Students also used TEL activities to prepare for F2F sessions, particularly for
522 practical classes, with students perceiving these materials as a benefit. Just like
523 any educational intervention, motivation to engage with a topic is likely to affect

524 student engagement (42). In our study, it is possible that students were
525 interested in doing well in F2F practical classes as topics covered were perceived
526 as important to their future career choices as veterinary surgeons (23). Clearly,
527 incorporating relevance and interest in TEL activities is integral in BL courses.
528 For example, students interested in farm animal career pathways particularly
529 commented on the relevance of the module. Highlighting the relevance and
530 transferable skills gained from completing course activities may increase
531 engagement with students less interested in specific topics within a BL course.

532
533 Students described both F2F and TEL activities positively but highlighted that
534 F2F and TEL activities should be complementary, rather than TEL used simply to
535 replace F2F sessions. Getting the right “blend” of F2F and TEL activities is
536 integral to the success of a BL course (43). Other research also found that F2F
537 activities followed by TEL activities leads to students engaging with the content
538 more than students access to only TEL activities (44). Blended learning activities
539 within a course should be designed and mapped to the appropriate learning
540 outcomes of the course (45) as certain topics are more suited to F2F or TEL
541 activities. Specifically, we found that students appreciated TEL when its used to
542 complement F2F sessions, such as in preparation for practical classes by
543 studying online videos or a textbook. In other work, Morton and others explored
544 medical and biomedical student engagement with a new BL course in
545 pharmacology through small focus groups (16). Students identified other
546 courses that could be suited to BL approaches, particularly those that taught core
547 principles that moved onto real-life application of the content. Yet in our survey,
548 students had a mixed response to TEL activities that built on background
549 knowledge, particularly where learning built on content from previous studies in
550 their degree course. Getting students to revisit previously learnt material can be
551 a challenge and partly depends on how well they learnt it the first time. Students,
552 who are less familiar with the background knowledge may feel they spend longer
553 than expected on these activities leading to demotivation and failure to meet
554 learning outcomes (46). Students commented that unpredictability in activity
555 participation time made it difficult to prioritise their learning, particularly in TEL
556 activities that required students to research topics beyond core course materials.
557 As previously mentioned, signposting could be a potential solution to this and
558 has been shown to increase students’ awareness of what is involved in a TEL
559 activity. For example, signposting has been shown to be useful with flipped
560 classroom techniques (47) and in large online learning environments (48,49).
561 Annotating TEL activities with the expected level of background knowledge,
562 associated course resources and expected time to complete an activity (e.g.
563 signposting) could improve student motivation and engagement with stand-
564 alone TEL activities.

565
566 Preserving lecturer interaction is very important in BL courses, as interaction
567 between students and their lecturer can increase the quality and effectiveness of
568 F2F sessions (50). Face-to-face activities encourage lecturer interaction whereas
569 TEL activities emphasise learner-material interactions (24). We found that
570 students missed the interaction with teaching staff and student peers, especially
571 for stand-alone TEL activities. Students requested more guidance to support
572 their learning for TEL activities that were predominately self-directed. Students

573 felt that in isolation TEL interaction with teachers was not as productive as F2F
574 interaction. Positive interactions with lecturers can improve student learning
575 (51,52) as one-on-one direction can assist individual students learning needs,
576 such as help in prioritising and clarifying course content. Students also value
577 being part of a learning community, as F2F sessions in BL courses can foster a
578 community spirit that encourages students to learn through supported
579 interaction with teachers and their peers (43). Virtual learning environments
580 design can maximise student-teacher interaction through discussion boards and
581 email. For example, a study by Beer and others demonstrated that the more
582 teachers communicate via VLE platforms the more students will engage with the
583 content (53). Although a study looking at veterinary student engagement with an
584 online only course highlighted that even though automated feedback was
585 provided online, students missed personal interaction with their teachers (54).
586 In the study, students particularly missed F2F teacher support in online case-
587 based problem solving activities to assist them with their approach. When
588 designing courses around BL principles, F2F and TEL activities should be
589 synergistic in order to support student engagement and academic achievement
590 as part of a learning community (55). Complementary F2F feedback sessions
591 with teaching staff at the end of the course can provide students with the
592 opportunity to interact with teaching staff directly about TEL resources used in
593 the course.

594
595 The online learning environment had an impact on how students engaged and
596 perceived their learning experience. Students were generally able to navigate
597 TEL resources hosted by the university's main VLE (Moodle®) however,
598 students were frustrated when they could not find activities hosted on another
599 VLE (Mahara®). Students also described software problems as a barrier to their
600 learning. Student perception of the format and design of the online learning
601 environment content can make a difference to how students engage with TEL
602 resources (56). There is a complex relationship between emotions, motivation,
603 cognition, metacognition and academic achievements. Thus an individual's
604 emotions, such as frustration, may demotivate and hinder cognitive processes
605 when using BL methodology (57). A large survey of over 500,000 biological
606 science students, undertaking blended learning courses, found that highly
607 frustrated students review less online course content and attain lower grades,
608 than those with low levels of frustration (58). It was clear in our study that on
609 occasion, frustrations related to the online learning environment, were
610 perceived to have hindered student learning. Despite these frustrations, students
611 continued to try to complete aspects of the course that had software problems.
612 For example, the pharmaceutical prescription, farm calendar activities and end
613 of module quiz, were mostly accessed multiple times by individual students.
614 Other studies highlight that software problems led to a drop off in student access
615 with students becoming demotivated and disengaged with TEL activities (59–
616 61). It is important to understand the nature of the frequency of interaction in
617 TEL activities and to establish whether the frequency of interaction is
618 productive. Although we did not ask specifically why students accessed some
619 TEL activities more than others, some of the TEL activities with the highest
620 frequency of access, had a grade associated with the completion of the activity
621 but also had the most negative feedback from students (pharmaceutical

622 prescription and end of module quiz activities). Drive to achieve higher grades,
623 may have led to students attempting the activity multiple times. The use of
624 grading to encourage students to complete TEL activities has been demonstrated
625 from a variety of formats (49,62,63). In addition, veterinary students are
626 regarded as highly motivated to succeed in their studies due to their passion for
627 their chosen career (64) and might partly explain their persistence with faulty
628 activities, as students perceived it was important to complete this activity as part
629 of their professional training. However, software frustrations may have had a
630 negative impact on the quality of their learning strategies. Parkinson et al,
631 highlighted that although veterinary students are generally motivated,
632 frustration and work overload might encourage them to utilise superficial rather
633 than deep learning approaches (42). Students' that utilise superficial approaches
634 retain knowledge for short-term recall, whilst those that utilise deep learning
635 approaches are able to apply knowledge in different contexts (21). For
636 veterinary training, deep learning is integral to developing clinical problem
637 solving skills (65). Like F2F activities, TEL activities should be aligned with ILOs
638 and software problems mitigated against to minimise student frustration. The
639 majority of the frustrations to software problems were related to automated
640 feedback in TEL activities that marked correct answers incorrectly. Veterinary
641 students appreciate sequential feedback with relevance to their future career
642 (54) and inappropriate feedback could be detrimental to their learning
643 experience. Troubleshooting TEL activities, through piloting new activities and
644 appropriate staff training in using software to design activities, is important to
645 limit the likelihood of software issues (66,67). As this was the first run of the
646 module teething problems were likely and highlights why trouble shooting is
647 particularly important for newly developed TEL activities. In addition, previous
648 experiences with TEL can influence future engagement with TEL (68). Veterinary
649 surgeons in the UK are required to conducted regular continued professional
650 development (CPD) throughout their careers (69). In recent years there has
651 been an increase in distance online based platforms for postgraduate education
652 of veterinary surgeons (9). Thus, it is important in TEL activities within
653 undergraduate veterinary BL courses do not discourage future engagement with
654 TEL.

655
656 This study had various limitations that should be considered when planning
657 future research. Our study only examined a relatively small number of students
658 for a snap shot in time on a single course. It is accepted that end of course
659 feedback is often given by students who have grievances about a course (70) and
660 with the course feedback questionnaire being optional, this may have biased our
661 results. However, end of course surveys and log data are useful for
662 understanding an individual's engagement and perceptions of a course (71) and
663 TEL platforms offer opportunities to monitor trends in student learning.
664 Conducting interviews or focus groups might have provided further depth to
665 student perceptions of BL methods (72), however the online questionnaire did
666 facilitate sampling a larger cohort of students. Our approach has been helpful to
667 identify factors to consider when using BL principles to design undergraduate
668 courses as part of routine course feedback. Few studies take advantage of such
669 audit tools (73) to research the use of BL principles in the training of veterinary
670 surgeons. Despite module design being focused around BL principles, the

671 students that participated in our study had been taught using BL methods for
672 two years. Students with little experience of BL courses, may have different
673 perceptions and encounter additional challenges when participating in these
674 courses for the first time. We did not assess access to online TEL resources from
675 the module as part of pre-exam preparation (four months after the end of the
676 course). Also, we could not investigate the nature of interaction with TEL
677 activities (e.g. depth of engagement) due to limitations in the data provided by
678 the VLE software. Other studies of online courses have identified that students
679 often may utilise TEL material more prior to exams (74). However, it is unclear
680 if such behaviours improve academic outcomes or, in the case of veterinary
681 training, alignment to professional competencies. Further research should focus
682 on improving academic staff's ability to estimate and allocate adequate
683 independent study time for students. For veterinary students in particular, how
684 the design of BL courses impact on students' own allocation of study time, which
685 may relate to their professional development and their wellbeing and mental
686 health. For this reason, future studies could consider whether TEL activity
687 guidance (sign-posting) assists students in managing their study time and
688 further prepares them for future independent study.

689

690 Assessing student perception and engagement with a BL course, has highlighted
691 the benefits and challenges of using BL principles in the undergraduate
692 education of veterinary students. Our findings support other work recognising
693 the importance of considering course context, organisation, student time
694 allocation skills, troubleshooting software errors and developing synergistic
695 resources when developing a blended course. Veterinary educators wishing to
696 incorporate BL methods in professional degree teaching, should consider these
697 factors to improve application of course content and support students to become
698 independent learners. While it is clear that a blended learning approach can be
699 effective in training the next generation of veterinary surgeons, there is
700 considerable scope for additional research to establish the most effective
701 techniques for implementing BL in veterinary and medical education.

702

703 **Acknowledgements**

704 We would like to thank all the staff of the Division of Farm Animal Clinical
705 Sciences for their assistance in producing teaching material and enthusiasm for
706 teaching veterinary students at the University of Glasgow. In addition to Mr
707 James McGoldrick of the Veterinary Parasitology department for assistance with
708 the parasitology resources and Mrs Lumba Chirwa for assistance with
709 management of UG-SVM VLE resources for the module. We would also like to
710 thank Dr Vicki Dale at the University of Glasgow, for her constructive comments
711 and suggestions on the first draft of this paper.

712

713 **References**

- 714 1. Rose E, McKee W, Temple BK, Harrison DK, Kirkwood D. Workplace
715 learning: a concept in off-campus teaching. *Learn Organ* [Internet]. 2001
716 May 14 [cited 2018 Oct 28];8(2):70–7. Available from:
717 <http://www.emeraldinsight.com/doi/10.1108/09696470110388017>
- 718 2. Kingston JH. *Educational Timetabling*. In Springer, Berlin, Heidelberg;

- 719 2013 [cited 2018 Oct 28]. p. 91–108. Available from:
720 http://link.springer.com/10.1007/978-3-642-39304-4_4
721 3. Cisneros V, Goldberg I, Schafenacker A, Bota RG. Balancing Life and
722 Medical School. *Ment Illn* [Internet]. 2015 Feb 24 [cited 2018 Oct
723 28];7(1):5768. Available from:
724 <http://www.ncbi.nlm.nih.gov/pubmed/26266023>
725 4. Knowles E. How to balance work and study [Internet]. *Prospects.ac.uk*.
726 2017 [cited 2018 Oct 28]. Available from:
727 [https://www.prospects.ac.uk/applying-for-university/university-](https://www.prospects.ac.uk/applying-for-university/university-life/how-to-balance-work-and-study)
728 [life/how-to-balance-work-and-study](https://www.prospects.ac.uk/applying-for-university/university-life/how-to-balance-work-and-study)
729 5. Holmes V. Working to live. *Educ + Train* [Internet]. 2008 May 30 [cited
730 2018 Oct 28];50(4):305–14. Available from:
731 <https://www.emeraldinsight.com/doi/10.1108/00400910810880542>
732 6. RCVS. Essential competences required of the veterinary surgeon. 2006.
733 7. Rodríguez-Martínez H. Quality commitment and management in
734 veterinary education. *J Vet Med Educ* [Internet]. 2006 [cited 2016 Sep
735 28];33(2):165–71. Available from:
736 <http://www.ncbi.nlm.nih.gov/pubmed/16849291>
737 8. Lumeij JT, Herrtage ME. Veterinary Specialization in Europe. *J Vet Med*
738 *Educ* [Internet]. 2006 Jun 10 [cited 2019 Feb 7];33(2):176–9. Available
739 from: <https://jvme.utpjournals.press/doi/10.3138/jvme.33.2.176>
740 9. Dale VHM, Sullivan M, May SA. Adult Learning in Veterinary Education:
741 Theory to Practice. *J Vet Med Educ* [Internet]. 2008 Dec 3 [cited 2018 Dec
742 20];35(4):581–8. Available from:
743 <https://jvme.utpjournals.press/doi/10.3138/jvme.35.4.581>
744 10. NMC. Horizon Report 2015 Higher Education Edition: Increasing use of
745 blended learning. 2015.
746 11. Dalsgaard C, Godsk M. Transforming traditional lectures into problem-
747 based blended learning: challenges and experiences. *Open Learn J Open,*
748 *Distance e-Learning* [Internet]. 2008 Jun 5 [cited 2016 Mar 21];22(1):29–
749 42. Available from:
750 <http://www.tandfonline.com/doi/abs/10.1080/02680510601100143>
751 12. Garrison DR, Kanuka H. Blended learning: Uncovering its transformative
752 potential in higher education. *Internet High Educ* [Internet]. 2004 Apr
753 [cited 2014 Jul 15];7(2):95–105. Available from:
754 <http://www.sciencedirect.com/science/article/pii/S1096751604000156>
755 13. Graham CR, Woodfield W, Harrison JB. A framework for institutional
756 adoption and implementation of blended learning in higher education.
757 *Internet High Educ*. 2013;18:4–14.
758 14. McLinden M. Flexible Pedagogies: part-time learners and learning in
759 higher education. *Audit Tool. Flexible Pedagogies: Preparing for the future*.
760 2013.
761 15. RCVS. CPD - the Future - RCVS [Internet]. London, UK; 2003 [cited 2015
762 Nov 16]. Available from: [http://www.rcvs.org.uk/document-library/cpd-](http://www.rcvs.org.uk/document-library/cpd-the-future/)
763 [the-future/](http://www.rcvs.org.uk/document-library/cpd-the-future/)
764 16. Morton CE, Saleh SN, Smith SF, Hemani A, Ameen A, Bennie TD, et al.
765 Blended learning: how can we optimise undergraduate student
766 engagement? *BMC Med Educ* [Internet]. 2016 Dec 4 [cited 2018 Nov
767 22];16(1):195. Available from:

- 768 [http://bmcmmededuc.biomedcentral.com/articles/10.1186/s12909-016-](http://bmcmmededuc.biomedcentral.com/articles/10.1186/s12909-016-0716-z)
769 [0716-z](http://bmcmmededuc.biomedcentral.com/articles/10.1186/s12909-016-0716-z)
- 770 17. Lehmann R, Bosse HM, Simon A, Nikendei C, Huwendiek S. An innovative
771 blended learning approach using virtual patients as preparation for skills
772 laboratory training: perceptions of students and tutors. *BMC Med Educ*
773 [Internet]. 2013 Dec 12 [cited 2019 May 8];13(1):23. Available from:
774 [https://bmcmmededuc.biomedcentral.com/articles/10.1186/1472-6920-](https://bmcmmededuc.biomedcentral.com/articles/10.1186/1472-6920-13-23)
775 [13-23](https://bmcmmededuc.biomedcentral.com/articles/10.1186/1472-6920-13-23)
- 776 18. Duque G, Demontiero O, Whereat S, Gunawardene P, Leung O, Webster P,
777 et al. Evaluation of a blended learning model in geriatric medicine: A
778 successful learning experience for medical students. *Australas J Ageing*
779 [Internet]. 2013 Jun 1 [cited 2019 May 8];32(2):103–9. Available from:
780 <http://doi.wiley.com/10.1111/j.1741-6612.2012.00620.x>
- 781 19. Ilic D, Nordin R Bin, Glasziou P, Tilson JK, Villanueva E. A randomised
782 controlled trial of a blended learning education intervention for teaching
783 evidence-based medicine. *BMC Med Educ* [Internet]. 2015 Dec 10 [cited
784 2019 May 8];15(1):39. Available from:
785 [https://bmcmmededuc.biomedcentral.com/articles/10.1186/s12909-015-](https://bmcmmededuc.biomedcentral.com/articles/10.1186/s12909-015-0321-6)
786 [0321-6](https://bmcmmededuc.biomedcentral.com/articles/10.1186/s12909-015-0321-6)
- 787 20. Nichol DJ, Macfarlane-Dick D. Formative assessment and self regulating
788 learning: a model and seven principles of good feedback practice. *Stud*
789 *High Educ.* 2006;31(2).
- 790 21. Richardson JTE. Student's approaches to learning and teachers approaches
791 to teaching in higher education. *Educ Psychology.* 2006;25(6):673–80.
- 792 22. Lane EA. Problem-based learning in veterinary education. *J Vet Med Educ*
793 [Internet]. 2008 [cited 2016 Sep 28];35(4):631–6. Available from:
794 <http://www.ncbi.nlm.nih.gov/pubmed/19228919>
- 795 23. Rhind SM, Baillie S, Kinnison T, Shaw DJ, Bell CE, Mellanby RJ, et al. The
796 transition into veterinary practice: Opinions of recent graduates and final
797 year students. *BMC Med Educ* [Internet]. 2011 Dec 22 [cited 2016 Oct
798 14];11(1):64. Available from:
799 [http://bmcmmededuc.biomedcentral.com/articles/10.1186/1472-6920-11-](http://bmcmmededuc.biomedcentral.com/articles/10.1186/1472-6920-11-64)
800 [64](http://bmcmmededuc.biomedcentral.com/articles/10.1186/1472-6920-11-64)
- 801 24. Bonk C, Graham C. *The handbook of blended learning: Global perspectives,*
802 *local designs.* New York: Pfeiffer; 2005.
- 803 25. May SA. Modern Veterinary Graduates Are Outstanding, But Can They Get
804 Better? *J Vet Med Educ* [Internet]. 2008 Dec [cited 2016 Sep
805 28];35(4):573–80. Available from:
806 <http://jvme.utpjournals.press/doi/10.3138/jvme.35.4.573>
- 807 26. Heinze A, Procter C. Reflections on the use of blended learning. In:
808 *Education in a Changing Environment* [Internet]. Salford, UK: University of
809 Salford, Salford; 2004 [cited 2016 Mar 21]. Available from:
810 http://usir.salford.ac.uk/1658/1/4247745025H_CP_-_paper9_5.pdf
- 811 27. University of Glasgow. *E-Learning strategy 2013-2020.* Glasgow; 2013.
- 812 28. Williams B. Case based learning—a review of the literature: is there scope
813 for this educational paradigm in prehospital education? *Emerg Med J*
814 [Internet]. 2005 Aug 1 [cited 2019 May 8];22(8):577–81. Available from:
815 <http://www.ncbi.nlm.nih.gov/pubmed/16046764>
- 816 29. Allen IE, Seaman CA. *Likert Scales and Data Analyses.* Qual Prog.

- 817 2007;40(7):64–5.
- 818 30. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*
819 [Internet]. 2006 Jan [cited 2016 Oct 14];3(2):77–101. Available from:
820 <http://www.tandfonline.com/doi/abs/10.1191/1478088706qp063oa>
- 821 31. Silverman D. *Qualitative research : theory, method and practice*. Sage
822 Publications; 2004. 378 p.
- 823 32. Maxwell JA. Using Numbers in Qualitative Research. *Qual Inq* [Internet].
824 2010 Jul 15 [cited 2019 May 31];16(6):475–82. Available from:
825 <http://journals.sagepub.com/doi/10.1177/1077800410364740>
- 826 33. RCVS. Code of Professional Conduct for Veterinary Surgeons - RCVS
827 [Internet]. 2015 [cited 2015 Nov 16]. p. 16. Available from:
828 [http://www.rcvs.org.uk/advice-and-guidance/code-of-professional-](http://www.rcvs.org.uk/advice-and-guidance/code-of-professional-conduct-for-veterinary-surgeons/)
829 [conduct-for-veterinary-surgeons/](http://www.rcvs.org.uk/advice-and-guidance/code-of-professional-conduct-for-veterinary-surgeons/)
- 830 34. Brennan J, Williams R. Learning and Teaching Support Network Collecting
831 and using student feedback. A guide to good practice collecting and using
832 student feedback. [Internet]. York, UK; 2004 [cited 2019 May 8]. Available
833 from: http://www.hefce.ac.uk/pubs/rdreports/2003/rd08_03/
- 834 35. Elen J, Clarebout G, Leonard R, Lowyck J. Student-centred and teacher-
835 centred learning environments: what students think. *Teach High Educ*.
836 2007;12(1):105–17.
- 837 36. Rachman R. Student centred learning. *Pract Soc Work action* [Internet].
838 2008 May 1 [cited 2015 Nov 27];1(2):173–89. Available from:
839 <http://www.tandfonline.com/doi/abs/10.1080/09503158708416841>
- 840 37. Holley D, Dobson C. Encouraging student engagement in a blended
841 learning environment: the use of contemporary learning spaces. *Learn*
842 *Media Technol* [Internet]. 2008 Jun 21 [cited 2018 Nov 28];33(2):139–50.
843 Available from:
844 <https://www.tandfonline.com/doi/full/10.1080/17439880802097683>
- 845 38. Halliwell REW, Downes M, Adams VJ, Allister R, Harrison W, Mellanby RJ,
846 et al. Stress in new graduates: can the profession do more to help? *Vet Rec*
847 [Internet]. 2016 Jun 18 [cited 2019 Feb 7];178(25):635–6. Available from:
848 <http://www.ncbi.nlm.nih.gov/pubmed/27313254>
- 849 39. Bartram DJ, Yadegarfar G, Baldwin DS. A cross-sectional study of mental
850 health and well-being and their associations in the UK veterinary
851 profession. *Soc Psychiatry Psychiatr Epidemiol* [Internet]. 2009 Dec [cited
852 2016 Feb 2];44(12):1075–85. Available from:
853 <http://www.ncbi.nlm.nih.gov/pubmed/19294320>
- 854 40. Reisbig AMJ, Danielson JA, Wu T-F, Hafen M, Krienert A, Girard D, et al. A
855 Study of Depression and Anxiety, General Health, and Academic
856 Performance in Three Cohorts of Veterinary Medical Students across the
857 First Three Semesters of Veterinary School. *J Vet Med Educ* [Internet].
858 2012 Dec 1 [cited 2018 Dec 7];39(4):341–58. Available from:
859 <https://jvme.utpjournals.press/doi/10.3138/jvme.0712-065R>
- 860 41. Cardwell JM, Lewis EG, Smith KC, Holt ER, Baillie S, Allister R, et al. A cross-
861 sectional study of mental health in UK veterinary undergraduates. *Vet Rec*
862 [Internet]. 2013 Sep 21 [cited 2018 Dec 7];173(11):266. Available from:
863 <http://www.ncbi.nlm.nih.gov/pubmed/23956162>
- 864 42. Parkinson TJ, Gilling M, Suddaby GT. Workload, Study Methods, and
865 Motivation of Students within a BVSc Program. *J Vet Med Educ* [Internet].

- 866 2006 Jun 10 [cited 2018 Dec 6];33(2):253–65. Available from:
867 <https://jvme.utpjournals.press/doi/10.3138/jvme.33.2.253>
- 868 43. Sánchez-Mendiola M, Martínez-Franco AI, Rosales-Vega A, Villamar-Chulin
869 J, Gatica-Lara F, García-Durán R, et al. Development and implementation of
870 a biomedical informatics course for medical students: challenges of a
871 large-scale blended-learning program. *J Am Med Informatics Assoc*
872 [Internet]. 2013 Mar 1 [cited 2018 Nov 28];20(2):381–7. Available from:
873 [https://academic.oup.com/jamia/article-lookup/doi/10.1136/amiajnl-](https://academic.oup.com/jamia/article-lookup/doi/10.1136/amiajnl-2011-000796)
874 [2011-000796](https://academic.oup.com/jamia/article-lookup/doi/10.1136/amiajnl-2011-000796)
- 875 44. Gros B, Garcia I, Escofet A. Beyond the net generation debate: A
876 comparison between digital learners in face-to-face and virtual
877 universities. *Int Rev Res Open Distrib Learn* [Internet]. 2012 Oct 1 [cited
878 2018 Nov 28];13(4):190. Available from:
879 <http://www.irrodl.org/index.php/irrodl/article/view/1305>
- 880 45. Franklin S, Peat M. Managing change: The use of mixed delivery modes to
881 increase learning opportunities. *Australas J Educ Technol* [Internet]. 2001
882 Apr 27 [cited 2018 Nov 28];17(1). Available from:
883 <http://ajet.org.au/index.php/AJET/article/view/1771>
- 884 46. Ke F, Kwak D. Online learning across ethnicity and age: A study on learning
885 interaction participation, perception, and learning satisfaction. *Comput*
886 *Educ* [Internet]. 2013 Feb 1 [cited 2018 Dec 5];61:43–51. Available from:
887 <https://www.sciencedirect.com/science/article/pii/S0360131512002072>
- 888 47. McGrath D, Groessler A, Fink E, Reidsema C, Kavanagh L. Technology in the
889 Flipped Classroom. In: *The Flipped Classroom* [Internet]. Singapore:
890 Springer Singapore; 2017 [cited 2018 Dec 5]. p. 37–56. Available from:
891 http://link.springer.com/10.1007/978-981-10-3413-8_3
- 892 48. Hughes H. International students using online information resources to
893 learn: complex experience and learning needs. *J Furth High Educ*
894 [Internet]. 2013 Jan [cited 2018 Dec 5];37(1):126–46. Available from:
895 <http://www.tandfonline.com/doi/abs/10.1080/0309877X.2011.644778>
- 896 49. Kizilcec RF, Pérez-Sanagustín M, Maldonado JJ. Self-regulated learning
897 strategies predict learner behavior and goal attainment in Massive Open
898 Online Courses. *Comput Educ* [Internet]. 2017 Jan [cited 2018 Dec
899 18];104(C):18–33. Available from:
900 <https://linkinghub.elsevier.com/retrieve/pii/S0360131516301798>
- 901 50. Curtis DD, Lawson MJ. Exploring collaborative online learning. *J*
902 *Asynchronous Learn Networks* [Internet]. 2001 May 1 [cited 2018 Nov
903 28];5(1):21–35. Available from:
904 [http://go.galegroup.com.ezproxy.is.ed.ac.uk/ps/retrieve.do?tabID=T002&](http://go.galegroup.com.ezproxy.is.ed.ac.uk/ps/retrieve.do?tabID=T002&resultListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearchForm¤tPosition=1&docId=GALE%7CA288538516&docType=Report&sort=RELEVANCE&contentSegment=&prodId=AONE)
905 [resultListType=RESULT_LIST&searchResultsType=SingleTab&searchType](http://go.galegroup.com.ezproxy.is.ed.ac.uk/ps/retrieve.do?tabID=T002&resultListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearchForm¤tPosition=1&docId=GALE%7CA288538516&docType=Report&sort=RELEVANCE&contentSegment=&prodId=AONE)
906 [=AdvancedSearchForm¤tPosition=1&docId=GALE%7CA28853851](http://go.galegroup.com.ezproxy.is.ed.ac.uk/ps/retrieve.do?tabID=T002&resultListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearchForm¤tPosition=1&docId=GALE%7CA288538516&docType=Report&sort=RELEVANCE&contentSegment=&prodId=AONE)
907 [6&docType=Report&sort=RELEVANCE&contentSegment=&prodId=AONE](http://go.galegroup.com.ezproxy.is.ed.ac.uk/ps/retrieve.do?tabID=T002&resultListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearchForm¤tPosition=1&docId=GALE%7CA288538516&docType=Report&sort=RELEVANCE&contentSegment=&prodId=AONE)
908 [&](http://go.galegroup.com.ezproxy.is.ed.ac.uk/ps/retrieve.do?tabID=T002&resultListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearchForm¤tPosition=1&docId=GALE%7CA288538516&docType=Report&sort=RELEVANCE&contentSegment=&prodId=AONE)
- 909 51. Sagayadevan V, Jeyaraj S. The role of emotional engagement in lecturer-
910 student interaction and the impact on academic outcomes of student
911 achievement and learning [Internet]. Vol. 12, *Journal of the Scholarship of*
912 *Teaching and Learning*. 2012 [cited 2018 Dec 5]. Available from:
913 <https://files.eric.ed.gov/fulltext/EJ992115.pdf>
- 914 52. Shu H, Gu X. Determining the differences between online and face-to-face

- 915 student–group interactions in a blended learning course. *Internet High*
916 *Educ* [Internet]. 2018 Oct 1 [cited 2018 Dec 7];39:13–21. Available from:
917 <https://www.sciencedirect.com/science/article/pii/S1096751617305407>
- 918 53. Beer C, Beer C, Clark K, Jones D. Indicators of engagement. *ASCILITE - Aust*
919 *Soc Comput Learn Tert Educ* [Internet]. 2010 [cited 2018 Nov
920 28];2010(1):75–86. Available from:
921 <https://www.learntechlib.org/p/45369/>
- 922 54. Allenspach K, Bell J, Whittlestone KD. Interactive Clinical Cases in
923 *Veterinary Education Used to Promote Independent Study. J Vet Med Educ*
924 [Internet]. 2008 Dec 4 [cited 2018 Dec 11];35(4):589–94. Available from:
925 <https://jvme.utpjournals.press/doi/10.3138/jvme.35.4.589>
- 926 55. Delahunty J, Verenikina I, Jones P. Socio-emotional connections: identity,
927 belonging and learning in online interactions. A literature review. *Technol*
928 *Pedagog Educ* [Internet]. 2014 Apr 3 [cited 2018 Dec 18];23(2):243–65.
929 Available from:
930 <http://www.tandfonline.com/doi/abs/10.1080/1475939X.2013.813405>
- 931 56. Oncu S, Cakir H. Research in online learning environments: Priorities and
932 methodologies. *Comput Educ* [Internet]. 2011 Aug [cited 2018 Dec
933 7];57(1):1098–108. Available from:
934 <https://linkinghub.elsevier.com/retrieve/pii/S0360131511000054>
- 935 57. Pekrun R. The Control-Value Theory of Achievement Emotions:
936 Assumptions, Corollaries, and Implications for Educational Research and
937 Practice. *Educ Psychol Rev* [Internet]. 2006 Nov 30 [cited 2018 Nov
938 28];18(4):315–41. Available from:
939 <http://link.springer.com/10.1007/s10648-006-9029-9>
- 940 58. Ramirez-Arellano A, Acosta-Gonzaga E, Bory-Reyes J, Hernández-Simón
941 LM. Factors affecting student learning performance: A causal model in
942 higher blended education. *J Comput Assist Learn* [Internet]. 2018 Dec 1
943 [cited 2018 Nov 28];34(6):807–15. Available from:
944 <http://doi.wiley.com/10.1111/jcal.12289>
- 945 59. Swinnerton BJ, Morris NP, Hotchkiss S, Pickering JD. The integration of an
946 anatomy massive open online course (MOOC) into a medical anatomy
947 curriculum. *Anat Sci Educ* [Internet]. 2017 Jan [cited 2018 Dec
948 20];10(1):53–67. Available from: <http://doi.wiley.com/10.1002/ase.1625>
- 949 60. Muilenburg LY, Berge ZL. Student barriers to online learning: A factor
950 analytic study. *Distance Educ* [Internet]. 2005 Jan 19 [cited 2016 Mar
951 8];26(1):29–48. Available from:
952 <http://www.tandfonline.com/doi/abs/10.1080/01587910500081269>
- 953 61. Song L, Singleton ES, Hill JR, Koh MH. Improving online learning: Student
954 perceptions of useful and challenging characteristics. *Internet High Educ*
955 [Internet]. 2004 Jan [cited 2016 Feb 1];7(1):59–70. Available from:
956 <http://www.sciencedirect.com/science/article/pii/S1096751603000885>
- 957 62. Kibble J. Use of unsupervised online quizzes as formative assessment in a
958 medical physiology course: effects of incentives on student participation
959 and performance. *Adv Physiol Educ* [Internet]. 2007 Sep [cited 2018 Dec
960 20];31(3):253–60. Available from:
961 <http://www.physiology.org/doi/10.1152/advan.00027.2007>
- 962 63. Johnson BC, Kiviniemi MT. The Effect of Online Chapter Quizzes on Exam
963 Performance in an Undergraduate Social Psychology Course. *Teach*

- 964 Psychol [Internet]. 2009 Jan 2 [cited 2018 Dec 20];36(1):33–7. Available
965 from: <http://journals.sagepub.com/doi/10.1080/00986280802528972>
966 64. Mikkonen J, Ruohoniemi M. How Do Veterinary Students' Motivation and
967 Study Practices Relate to Academic Success? *J Vet Med Educ* [Internet].
968 2011 Sep 1 [cited 2018 Dec 11];38(3):298–304. Available from:
969 <https://jvme.utpjournals.press/doi/10.3138/jvme.38.3.298>
970 65. Khosa DK, Volet SE, Bolton JR. An Instructional Intervention to Encourage
971 Effective Deep Collaborative Learning in Undergraduate Veterinary
972 Students. *J Vet Med Educ* [Internet]. 2010 Dec 1 [cited 2018 Dec
973 20];37(4):369–76. Available from:
974 <https://jvme.utpjournals.press/doi/10.3138/jvme.37.4.369>
975 66. Anderson T. Theory and practice of online learning [Internet]. AU Press;
976 2008 [cited 2018 Dec 20]. Available from:
977 [https://books.google.co.uk/books?hl=en&lr=&id=RifNwzU3HR4C&oi=fnd
978 &pg=PA91&dq=staff+online+courses&ots=Sg9nJfJrlw&sig=qcy0Mnnqb0t
979 7sWJFXBoLy3ddvhs#v=onepage&q=staff+online+courses&f=false](https://books.google.co.uk/books?hl=en&lr=&id=RifNwzU3HR4C&oi=fnd&pg=PA91&dq=staff+online+courses&ots=Sg9nJfJrlw&sig=qcy0Mnnqb0t7sWJFXBoLy3ddvhs#v=onepage&q=staff+online+courses&f=false)
980 67. Elliis A, Phelps R. Australasian journal of educational technology.
981 [Internet]. Vol. 16, Australasian Journal of Educational Technology.
982 Australian Society for Educational Technology; 2004 [cited 2018 Dec 20].
983 Available from:
984 <https://ajet.org.au/index.php/AJET/article/view/1820/885>
985 68. Sun P-C, Tsai RJ, Finger G, Chen Y-Y, Yeh D. What drives a successful e-
986 Learning? An empirical investigation of the critical factors influencing
987 learner satisfaction. *Comput Educ* [Internet]. 2008 May [cited 2018 Dec
988 20];50(4):1183–202. Available from:
989 <http://linkinghub.elsevier.com/retrieve/pii/S0360131506001874>
990 69. RCVS. RCVS: Continuing Professional Development (CPD) [Internet]. 2018
991 [cited 2018 Dec 20]. Available from: [https://www.rcvs.org.uk/lifelong-
992 learning/continuing-professional-development-cpd/](https://www.rcvs.org.uk/lifelong-learning/continuing-professional-development-cpd/)
993 70. Linse AR. Interpreting and using student ratings data: Guidance for faculty
994 serving as administrators and on evaluation committees. *Stud Educ Eval*
995 [Internet]. 2017 Sep 1 [cited 2019 Feb 20];54:94–106. Available from:
996 [https://www.sciencedirect.com/science/article/pii/S0191491X1630023
997 2](https://www.sciencedirect.com/science/article/pii/S0191491X16300232)
998 71. Macfadyen LP, Dawson S. Mining LMS data to develop an “early warning
999 system” for educators: A proof of concept. *Comput Educ* [Internet]. 2010
1000 Feb 1 [cited 2018 Nov 28];54(2):588–99. Available from:
1001 [https://www.sciencedirect.com/science/article/pii/S0360131509002486
1002 ?via%3Dihub](https://www.sciencedirect.com/science/article/pii/S0360131509002486?via%3Dihub)
1003 72. Adams A, Cox AL. Questionnaires, in-depth interviews and focus groups.
1004 In: *Research Methods for Human Computer Interaction*. Cambridge, UK:
1005 Cambridge University Press; 2008. p. 17–34.
1006 73. Tempelaar DT, Rienties B, Giesbers B. In search for the most informative
1007 data for feedback generation: Learning analytics in a data-rich context.
1008 *Comput Human Behav* [Internet]. 2015 Jun 1 [cited 2018 Nov 28];47:157–
1009 67. Available from:
1010 [https://www.sciencedirect.com/science/article/pii/S0747563214003240
1011 ?via%3Dihub](https://www.sciencedirect.com/science/article/pii/S0747563214003240?via%3Dihub)
1012 74. Gross D, Pietri ES, Anderson G, Moyano-Camihort K, Graham MJ. Increased

1013 Preclass Preparation Underlies Student Outcome Improvement in the
 1014 Flipped Classroom. Ledbetter ML, editor. CBE—Life Sci Educ [Internet].
 1015 2015 Dec [cited 2018 Dec 20];14(4):ar36. Available from:
 1016 <https://www.lifescied.org/doi/10.1187/cbe.15-02-0040>

1017 Figures

1018
 1019 **Figure 1. Structure of the curriculum of the BVMS degree program at the Glasgow**
 1020 **University School of Veterinary Medicine based on a spiral curriculum model.**

1021
 1022 (2a) An example of a type of TEL in the form of farm animal clinical examination videos provided
 1023 on the UG-SVM VLE for the clinical examination practical.

1024 (2b) An example of a type of TEL in the form of a self-directed learning pharmaceutical label CBL.
 1025 To be worked through in own time to apply clinical skills on prescribing pharmaceuticals by
 1026 completing the online forms from the provided clinical scenario.

1027 **Figure 2. Examples of TEL activities provided throughout the module.**

1028
 1029 **Figure 3. Bar plot of the proportion of students using the online resources within the**
 1030 **module and two weeks after (n=123).**

1031
 1032 **Figure 4. Bar plot of the frequency of use of online resources, by students, within the**
 1033 **module and two weeks after (n=123).**

1034
 1035 **Figure 5. Bar plot of the times of use of online resources, by all students, within the**
 1036 **module and two weeks after (n=123). Squares= Online guidance and lecture material;**
 1037 **Lines= Online textbook resources (Videos and images); Diamonds= Online CBLs; Solid**
 1038 **black= End of module quiz.**

1039
 1040 **Figure 6. An example of an incorrectly marked answer, from the online pharmaceutical**
 1041 **label CBL on the UG-SVM VLE that was actually correct. Also an example of detailed**
 1042 **explanatory feedback possible.**

1044 Tables

1045

Questionnaire statement	Percentage of students by Likert scale					
	Number of statements	Strongly Disagree (SA)	Disagree (D)	Neutral (N)	Agree (A)	Strongly Agree (SA)
1. Overall, I was satisfied with this module.	55	1.8%	0.0%	9.1%	63.6%	25.5%
2. The module was well organised.	55	1.8%	3.6%	16.4%	54.6%	23.6%
3. I was easily able to find module information on the	55	0.0%	1.8%	12.7%	67.3%	18.2%

virtual learning environment.						
4. Any changes to the module structure were communicated effectively online.	55	1.8%	5.5%	21.8%	56.4%	14.6%
5. It was made clear to me what I was expected to learn in this module.	55	1.8%	3.6%	16.4%	63.6%	14.6%
6. Overall teaching staff made this module interesting.	55	0.0%	0.0%	12.7%	61.8%	25.5%
7. The module content was pitched at the right level.	55	0.0%	1.8%	14.6%	65.5%	18.2%
8. The workload of this module was manageable.	55	0.0%	3.6%	18.2%	61.8%	16.4%
9. Staff during practicals or CBLs provided me with feedback that helped me understand how I am doing and how I could do better.	55	1.8%	1.8%	21.8%	61.8%	12.7%
10. I found the beef/ sheep calendar online CBLs useful.	55	3.6%	9.1%	34.6%	50.9%	1.8%
11. I found the pharmaceutical prescription online CBL useful.	55	7.3%	47.3%	38.2%	5.5%	1.8%
12. I found the additional online ruminant parasitology reference resources useful.	55	0.0%	9.1%	30.9%	52.7%	7.3%
13. The farm scenario assessment within the module stimulated my	55	1.8%	1.8%	20.0%	63.6%	10.9%

interest in the lecture content.						
14. The farm scenario assessment within the module helped tie together the lecture content.	55	1.8%	0.0%	25.5%	63.6%	7.3%
15. I received adequate instructions on the farm scenario assessment.	55	3.6%	3.6%	25.5%	58.2%	3.6%
16. The group work in practical classes, CBL and assessment improved my ability to work in a team.	55	1.8%	7.3%	29.1%	49.1%	10.9%
17. Online material, IT provision and support via forum posts were adequate for my needs.	55	0.0%	3.6%	21.8%	65.5%	9.1%
18. The online resources available were relevant.	55	0.0%	0.0%	18.2%	67.3%	12.7%

1046 **Table 1. Student statements to Likert scale questions (n=55).** Most frequent response
1047 highlighted in grey.

1048

Subtheme	Total number of questionnaire statements	Major theme	Total number of questionnaire statements
Synergistic resources	55	Balance of F2F and TEL resources	93
Student-lecturer interaction	18		
Module content organisation	67	Module design and delivery factors	67
Time management and allocation	43		
Software limitations	9		
Relevance to student career	10	Participant factors	43
Range in student ability	29		

1049 **Table 2. Summary of thematic analysis on student questionnaire statements (n=195**
1050 **statements from 55 students).** A response may be categorised to more than one subtheme.
1051

1052 Thus the total number of major or subtheme statements does not equal the total number of
 1053 questionnaire statements.

1054

1055 **Supplementary material**

1056

Type of activity	Name of activity	Description of activity	Class size and length (If applicable)
Lectures	Various topics in farm animal clinical medicine	Lecture based module, in a lecture theatre with clinical experts on various subjects.	30x 1 hour lectures with the whole class.
Practical classes	Clinical examination practical	In small groups, students examine 3 cases for 30 minutes each and work out a problem list at the farm animal clinic.	3x 1 case per 30 minute per station with 6-7 students. One clinical teacher per case.
	Population medicine practical	In small groups, students apply herd and flock health clinical skills at 3 practical stations on housing, nutrition and diagnostic sampling at the University farm.	3x 30 minute per station with 6-7 students. One clinical teacher per station.
	Parasitology practical	Students work through 12 diagnostic stations to identify parasites of farm animals and answer questions on treatment protocols.	1x 1 hour class with 11-12 students. One parasitology teachers per group of students.
Case-based learning classes	Anthelmintic and antibiotic selection	Students work on, present and discuss 3 case scenarios on selection of diagnostics and pharmaceuticals. Case scenarios are provided online prior the class to prepare for discussions.	2x 1 hour class with 22-23 students.
TECHNOLOGY ENHANCED LEARNING			
Type of activity	Name and VLE hosting the activity.	Description of activity	Class size and length (If applicable)

Complementary resources for F2F teaching.	Module organisation (Moodle®).	i. Various guidance documents with additional reading references for lectures, practical and CBL classes. ii. Online forum to discuss module topics with staff.	Available throughout the module.
	Clinical examination videos (Mahara®).	Farm animal clinical examination written guidance and narrated videos to prepare students for clinical examination practical.	Available throughout the module.
	Parasitology textbook (Mahara®).	Farm animal parasitology image textbook to prepare students for parasitology practical.	Available throughout the module.
Online case-based learning	Farm animal calendar (Moodle®).	Students are required to create a calendar for example beef and sheep farms. The calendars include key points in the animal production cycle and veterinary interventions. An online form is used to facilitate this.	Available throughout the module.
	Pharmaceutical prescription (Moodle®).	Students work through farm animal cases to design a treatment plan. Subsequently, students calculate drug dosages or write a prescription. The scenarios include individual animal and population cases.	Available throughout the module.
Assessment	End of module quiz (Moodle®).	A combination of free text, multiple choice (MCQ) and extended matching (EMQ) questions on various topics covered in the module.	Available throughout the module.

1057
1058
1059

	End of module summative assessment (Moodle®). ⁺	Submission of case-based assessment of a disease investigation report, farmer factsheet and revision poster.	Available throughout the module.
--	--	--	----------------------------------

Supplementary material 1. A summary of the F2F and TEL activities in the module. * Attendance recorded by a register. ⁺ The end of module summative assessment was an obligatory activity.

Question number	Question	Number of statements
Agreement questions (as Likert scale): State how much you agree with the following statements:		
1.	Overall, I was satisfied with this module.	55
2.	The module was well organised.	55
3.	I was easily able to find module information on the virtual learning environment.	55
4.	Any changes to the module structure were communicated effectively online.	55
5.	It was made clear to me what I was expected to learn in this module.	55
6.	Overall teaching staff made this module interesting.	55
7.	The module content was pitched at the right level.	55
8.	The workload of this module was manageable.	55
9.	Staff during practicals or CBLs provided me with feedback that helped me understand how I am doing and how I could do better.	55
10.	I found the beef/ sheep calendar online CBLs useful.	55
11.	I found the drug label online CBL useful.	55
12.	I found the additional online ruminant parasitology reference resources useful.	55
13.	The farm scenario assessment within the module stimulated my interest in the lecture content.	55
14.	The farm scenario assessment within the module helped tie together the lecture content.	55
15.	I received adequate instructions on the farm scenario assessment.	55
16.	The group work in practical classes, CBL and assessment improved my ability to work in a team.	55
17.	Online material, IT provision and support via forum posts were adequate for my needs.	55
18.	The online resources available were relevant.	55
Free-text questions:		
19.	Why did you find/ not find the beef/ sheep calendar online CBL useful?	49
20.	Why did you find/ not find the drug label online CBL useful?	50
21.	Why did you find/ not find the online ruminant parasitology resources useful?	46
22.	Identify any aspects of the teaching of this module that you particularly enjoyed and explain why	23

23.	Identify any issues/problems with the teaching of this module and suggest how this could be addressed	18
24.	Do you have any other comments about this module?	9

1060
1061
1062
1063

Supplementary material 2. Overall structure of the online student feedback questionnaire for the module. Agreement questions were recorded in a Likert scale, categorised as: Strongly disagree; Agree; Neutral; Agree; Strongly agree.