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1 **A survey to establish the extent of flipped classroom use prior to clinical skills laboratory**  
2 **teaching and determine potential benefits, challenges and possibilities**

3 **Authors:**

4 Molly Frendo Londgren, Ph.D. is a Medical Education Specialist with Michigan State  
5 University's (MSU) College of Human Medicine, 15 Michigan St NE, Room 369, Grand Rapids,  
6 MI 49503. She most recently served as the Curriculum and Education Specialist for MSU's  
7 College of Veterinary Medicine where she provided leadership to their curriculum  
8 reinvention. Her interests include educational psychology, educational technology,  
9 curriculum development, academic achievement, and medical education. Correspondence  
10 about this paper should be addressed to [frendo@msu.edu](mailto:frendo@msu.edu).

11 Sarah Baillie PhD, PFHEA, MRCVS is Emeritus Professor of Veterinary Education, Bristol  
12 Veterinary School, University of Bristol, Langford House, Langford, Bristol BS40 5DU, UK. Her  
13 interests include curriculum development, educational quality assurance, clinical skills  
14 laboratories, simulation and assessment.

15 Jennifer N. Roberts, DVM, DACT is an Adjunct Associate Professor in the Department of  
16 Large Animal Clinical Sciences, College of Veterinary Medicine, Michigan State University,  
17 East Lansing, MI 48824. Her interests include clinical skills education, integration of clinical  
18 skills into veterinary curricula, evaluation of educational impact of models and simulators,  
19 and implementation of learner centered teaching strategies.

20 Ioana M. Sonea, DMV, PhD is an Associate Professor in the Dept. of Pathobiology and  
21 Diagnostic Investigations, College of Veterinary Medicine, Michigan State University, East  
22 Lansing, MI 48824. Her interests include curricular development, assessment and  
23 improvement of teaching.

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28 **ABSTRACT**

29 Flipped classroom is a technique that involves a reordering of classroom and 'at-home'  
30 activities. Content provided prior to classroom interactions is used to prepare students for  
31 face-to-face classes. The flipped classroom has been shown to benefit students, including  
32 improvements in examination results and there is increasing interest in veterinary  
33 education. The current study aimed to investigate the potential of the flipped classroom  
34 approach to prepare students for practicals in a clinical skills laboratory. An online survey  
35 was distributed to the international veterinary clinical skills community to determine the  
36 extent to which flipped classroom is used prior to teaching in a clinical skills laboratory and  
37 how educators viewed the benefits, challenges, and possibilities. There were 101 survey  
38 participants representing 22 countries and all were involved in clinical skills teaching. Forty-  
39 two were using flipped classroom techniques prior to teaching in a clinical skills laboratory  
40 and 55 of the other participants would consider using the technique in this context in the  
41 future. Videos were the most common resource used. The main benefits, experienced or  
42 anticipated, were positive changes in student behavior, including preparation and better use  
43 of time during the practical by both the students and instructors. The main challenges were  
44 time for instructors to develop the materials, lack of student engagement with the flipped  
45 classroom, space in the curriculum, and institutional issues. In conclusion, there are many  
46 potential benefits that could be realized if a flipped approach was embedded prior to clinical  
47 skills laboratory practicals.

48 Key words: flipped classroom, clinical skills, clinical skills laboratory, clinical skills center,  
49 veterinary education

## 50 INTRODUCTION

51 As higher education looks to transform in order to stay relevant in producing a 21st century  
52 workforce, more and more institutions have begun to shift toward learner-centered  
53 teaching and away from content-centric lectures. Rather than utilizing in-class time to  
54 passively consume content, universities increasingly adopt active learning strategies that  
55 can help students practice the skills they need under the guidance of a content expert. One  
56 teaching method that has gained growing popularity through this transition is the flipped  
57 classroom. The flipped classroom is most broadly defined as a reordering of classroom and  
58 at-home activities (Bishop & Verleger, 2013). Some of the content that would traditionally  
59 have been delivered by the teacher becomes the homework used by students as self-  
60 directed learning to prepare for the face-to-face class, which may be a lecture, case-based  
61 learning session, laboratory practical or clinical skills class. During the flipped component  
62 students typically study key concepts through reading assignments, recorded mini-lectures  
63 or videos and assess their knowledge through quizzes. Advocates of the flipped classroom  
64 cite increased engagement during subsequent classroom time and enhanced ownership and  
65 flexibility of learning outside of the classroom (O'Flaherty & Phillips, 2015). The flipped  
66 classroom has been shown to have benefits for students, including significant improvements  
67 in examination results and overall increased student satisfaction, engagement, and skill  
68 development (Baepler et al., 2014; Murillow-Zamorano et al., 2019).

69 The flipped classroom approach is gaining popularity in veterinary education. A  
70 multinational survey found that 95% of participants were familiar with the concept of the  
71 flipped classroom, though only 65% had employed the technique themselves (Matthew et  
72 al., 2019). Veterinary educators have used flipped classroom strategies to build students'  
73 content knowledge in science (Dooley et al., 2018) as well as developing their professional  
74 skills (Moffett & Mill, 2014). The positive educational and student success outcomes of the  
75 flipped classroom within the context of medical education have been similar to other  
76 disciplines (Pierce & Fox, 2012; Ferreri & O'Connor, 2013). A growing body of literature  
77 shows the flipped classroom to be an increasingly common educational strategy in medical  
78 education with promising results in enhanced student performance on written exams  
79 (Shatto et al., 2017; Day, 2018; Chen et al., 2018). However, the impact on Objective

80 Structured Clinical Examination (OSCE) performance has been variable with studies  
81 reporting improvements or neutral effects (Gillispie, 2016; Chen et al., 2018).

82 As use of the flipped classroom has grown in veterinary medical education, clinical  
83 educators might logically use this pedagogical approach to teach clinical skills. The  
84 development of clinical skills is an essential part of veterinary medical education and,  
85 arguably, one of the most active components of many existing veterinary curricula. Use of  
86 flipped classroom strategies has become more commonplace in human medicine within the  
87 context of surgical and clinical skills education as studies find it to help with the  
88 development of skills, increase student engagement, and decrease time required from  
89 faculty (Liebert et al., 2016a; Liebert et al., 2016b; Chiu et al., 2017; Elledge et al., 2018). In  
90 veterinary medicine it is not uncommon to use video and narrated audio presentations prior  
91 to specific clinical skills practicals (Langebæk et al., 2016a; Langebæk et al., 2016; Read et  
92 al., 2016). However, there is limited research on the use of flipped classroom strategies in  
93 the context of clinical skills education. The aim of this study was to (a) understand how  
94 widespread the use of the flipped classroom is in the context of clinical skills laboratory  
95 teaching and (b) determine how clinical skills educators viewed the benefits, challenges, and  
96 possibilities of flipped classroom techniques in this context. The study received ethical  
97 approval from the Michigan State University Institutional Review Board (ID 00001830).

## 98 **METHODS**

### 99 **Survey design, delivery and distribution**

100 The survey questions were developed by the project team through discussion and with  
101 reference to the literature to identify areas to explore in relation to the use of the flipped  
102 classroom. At the beginning of the survey there was a brief description of the flipped  
103 classroom approach in education followed by a paragraph explaining that participants could  
104 withdraw at any time before submitting the survey. Completion of the survey indicated  
105 consent to the use of the responses in the study. Participants were informed that all data  
106 would be anonymous, stored in a secure location only accessible to the project team, and  
107 that the project had received ethics approval from Michigan State University.

108 The survey included basic demographic data (country, gender, and profession) and details  
109 about the individual participant's teaching (number of years involved with teaching and  
110 percentage of time involved with activities related to teaching clinical skills). The survey  
111 then branched depending on the participant's use of flipped classroom and familiarity with  
112 the term before starting the survey. For those familiar with the term, further questions  
113 explored the use of flipped classroom in their teaching and at their school. For those  
114 specifically using flipped classroom prior to teaching in a clinical skills laboratory, a series of  
115 questions explored what techniques were used, whether the flipped classroom was  
116 compulsory prior to the practical, and if/how it was assessed, as well as the perceived  
117 benefits, challenges, and suggestions for ways that flipped classroom could be used in the  
118 future. For those not using flipped classroom prior to teaching in a clinical skills laboratory  
119 and those who were not familiar with the term 'flipped classroom' before starting the  
120 survey, a series of questions explored suggestions for ways flipped classroom techniques  
121 could be used in the context of clinical skills laboratory teaching, potential benefits, and  
122 possible challenges.

123 The survey questions were piloted by colleagues and minor edits to text were made. The  
124 survey was administered online in Qualtrics<sup>a</sup> and the logic (branching) was thoroughly  
125 tested by the project team. The survey was distributed via clinical skills networks (Network  
126 Of Veterinarians In Continuing Education (NOVICE)<sup>b</sup> and International Veterinary Simulation  
127 in Teaching (InVeST)<sup>c</sup>) and through those involved with clinical skills teaching at other  
128 institutions.

### 129 **Analysis of quantitative and qualitative data**

130 The data were downloaded to Excel and filtered to identify the different subgroups based  
131 on their route through the survey. The free text comments were analyzed by two members  
132 of the project team (MF, SB). They independently used hand coding to identify themes and  
133 then compared and discussed the themes until reaching consensus.

## 134 RESULTS

### 135 Survey responses

136 There were 101 completed surveys; Figure 1 depicts participants' routes through the survey  
137 depending on their use of flipped classroom and familiarity with the term before starting  
138 the survey. The participants represented 22 countries with the majority from Europe and  
139 North America: UK (29), USA (23), Germany (7), Australia (6), Grenada (5), Ireland (5),  
140 Canada (4), Belgium (3), South Africa (3), The Netherlands (3), Norway (2), Argentina (1),  
141 Austria (1), Denmark (1), France (1), Hungary (1), India (1), Italy (1), Jordan (1), Poland (1),  
142 Spain (1) and Thailand (1). Most were veterinarians (85), followed by veterinary nurses /  
143 veterinary technicians (14 - from USA, Canada, UK & Ireland), one laboratory technician, and  
144 one selected 'Other' (model maker). Eighty-one were female, 18 were male, and two  
145 preferred not to say. All except one (model maker) were involved in teaching with a range of  
146 years of experience <1 to 43 (median = 10). Of the 100 involved in teaching, all spent some  
147 time teaching clinical skills ranging from 90-100% of their time (12), 70-90% (17), 50-70%  
148 (16), 30-50% (18), 10-30% (37).

149 *Figure 1: Survey participant responses based on the use of, and prior familiarity with, flipped*  
150 *classroom. Subgroups for the qualitative analysis are identified by numbers in ().*

151 For those familiar with the term flipped classroom before starting the survey (n = 80),  
152 questions then explored their experiences further. When asked if the flipped classroom  
153 approach was embedded in their curriculum, 35 (44%) responded 'yes', 31 responded 'no',  
154 and 14 were 'not sure'. Fifty-eight (74%) had integrated the flipped classroom approach in  
155 some area of their teaching; 22 had not used the technique in any context. Of those who  
156 had used the flipped classroom, just over three quarters felt 'very confident' (18) or 'fairly  
157 confident' (26) using the technique, followed by 'a little confident' (11), and 'not at all  
158 confident' (3). The context/s in which they had used flipped classroom were prior to  
159 'teaching in a clinical skills lab' (42), 'case-based learning' (25), 'group work' (24), 'lectures'  
160 (23), 'teaching in a clinical setting' (18), 'other laboratory-based teaching' (17), and 'Other'  
161 (1) described as "in CPD" (continuing education).

162 The use of flipped classroom was explored further with those who reported using the  
163 technique prior to teaching in a clinical skills laboratory. These participants (n = 42) were  
164 from USA (15), UK (9), Belgium (3), Ireland (3), Australia (2), Canada (2), Germany (2), The  
165 Netherlands (2), Denmark (1), Grenada (1), India (1), and South Africa (1). When asked if  
166 using the flipped classroom resources was compulsory prior to clinical skills laboratory  
167 sessions, the answers were: 'all sessions' (7), 'some sessions' (24), 'no' (10), and 'not sure'  
168 (1). Twenty reported that some type of assessment was included in the flipped classroom  
169 material. When asked if what the students had learned was checked at the start of the  
170 clinical skills laboratory teaching sessions, 23 answered 'yes', 18 'no', and 1 was 'not sure'.

171 Of those familiar with the term flipped classroom before starting the survey but not using it  
172 prior to teaching in a clinical skills laboratory, 35 (of 38) would consider using the technique  
173 prior to teaching in a clinical skills laboratory in the future. Of those not familiar with the  
174 term flipped classroom before starting the survey, 20 (of 21) would consider using it in that  
175 context in the future.

#### 176 **Qualitative data**

177 For the free text questions, the data were divided for the four subgroups of participants  
178 (Figure 1) and themes were identified for each (Table 1).

179 *Table 1: Themes emerging for the four subgroups from responses to free text questions*  
180 *about use of flipped classroom techniques prior to teaching in a clinical skills lab: techniques,*  
181 *benefits and challenges.*

#### 182 *i) Had used flipped classroom prior to teaching in a clinical skills laboratory*

183 When asked about approaches used for the flipped classroom prior to teaching in the  
184 clinical skills laboratory, video was the most commonly mentioned and was typically "*skills*  
185 *being explained and performed.*" Participants also described other types of flipped activities  
186 for students e.g. reading clinical skills booklets, watching and listening to a short PowerPoint  
187 with or without voiceover. In some instances, a comprehensive 'package' was described that  
188 combined multiple resources for example, "*Learning paths*" with text, pictures, videos etc."  
189 The flipped classroom often included a quiz "*students read our clinical skills booklets and*



190 *take a short quiz on the skills we'll be teaching them in the practical, prior to attending.*" In a  
191 few instances completing the flipped material was compulsory with a pass mark and/or  
192 access was monitored via the virtual learning environment and failure to engage could mean  
193 *"they cannot participate in the practical"*. A few mentioned ways of assessing the impact of  
194 the flipped material on student learning during the practical such as *"having the students do*  
195 *the skill"* before it was demonstrated/taught.

196 When asked to comment on the benefits, the responses were classified as for 'students' or  
197 'instructors'. For students, two main themes emerged. The first related to the effects on  
198 their behavior i.e. as a result of the flipped classroom students were more prepared,  
199 engaged, and confident: *"The great advantage in my opinion is that the students are*  
200 *prepared when they come to the skills lab"* and can *"engage more with the content and*  
201 *more readily ask questions"*. The second theme related to how students spend their time in  
202 the practical e.g. being able to get started straight away, more time doing hands-on (less  
203 reading or listening to an introduction) and learning/improving their technique, with the  
204 overall result that more can be achieved by the end of the practical: *"Students are able to*  
205 *get further in class because they come already with some knowledge of what is required. So*  
206 *they use class time to refine techniques, receive feedback, or practice, rather than have a*  
207 *demonstration."* For instructors the main benefits related to time: less time being required  
208 for explanation and demonstration of the basics; more time being available to teach the  
209 skills, help individuals having difficulty, and provide feedback: *"It saves me time going*  
210 *through some essentials and basics with every group, I can spend more time teaching what I*  
211 *need to be teaching and students need to learn."* Some participants included the caveat that  
212 if students don't engage with the flipped classroom, the benefits are variable or limited.

213 When asked about the challenges, a major theme emerged around the issues that  
214 instructors encountered: the time required to create the flipped material, keep existing  
215 material current, upload the material and inform students; institutional reluctance to  
216 embrace flipped classroom as an educational approach; clinical skills teaching not being part  
217 of the core curriculum; and some colleagues not wanting to use a flipped classroom and/or  
218 not understanding the concept. Often, a combination of challenges was identified e.g. *"The*  
219 *learning material has to be reorganized to work well as a self-directed activity - the time*  
220 *commitment can be very intense ... Faculty interest in investing time to adjust the content*

221 *and train the staff is almost inexistent as it requires an intensive time commitment before*  
222 *the sessions take place.”* Another major challenge was getting students to engage with the  
223 flipped material particularly if it was not assigned a mark and/or compulsory, if they did not  
224 have time, or because of their pre-existing expectations *“Students want lectures. It is hard*  
225 *for them to understand that techniques like this increase their learning”* although this was  
226 not always the case *“we have minimal to no push back from students.”* Instructors found it  
227 difficult to integrate those who had not prepared (not done the flipped classroom) in the  
228 subsequent practical class which caused problems *“Some students don't watch the videos in*  
229 *advance, which I find opens up the gap in ability and can become time consuming as you try*  
230 *to catch those students up with the rest of the group. It also raises questions around safety”*  
231 and concerns that *“they slow everyone up”*. However, several mentioned that students who  
232 have not passed or completed the flipped classroom were not allowed to attend the  
233 practical *“they now have to come back in a different session so this usually only happens*  
234 *once”*. A minor theme emerged around technical issues including *“video buffering”* and  
235 *“computer glitches”*.

236 The final question asked about other ways of using the flipped classroom in the future and  
237 suggestions related to having more videos *“Videos of frequently made mistakes and how the*  
238 *students can prevent the “mistakes””* and some mentioned specific skills e.g. *“I would like to*  
239 *create instrument identification and handling quiz”* or parts of a practical e.g. *“I’m going to*  
240 *review some of the repeated/introductory part. I am sure some/much of that could be*  
241 *flipped.”*

242 *ii) Were familiar with the term ‘flipped classroom’, were using it in teaching although not*  
243 *prior to teaching in a clinical skills laboratory but would consider doing so in the future*

244 When asked about the ways flipped classroom might be used prior to practicals in the  
245 clinical skills laboratory, the techniques identified were videos, reading (e.g. booklets or  
246 other relevant material), and quizzes. When asked about anticipated benefits, the major  
247 theme focused on the students and the potential for changes in their behavior, particularly  
248 improved preparation and better use of their time in the practical *“Students come prepared*  
249 *with knowledge activated, can focus on the practical aspects rather than the theory in the*  
250 *lab.”* The main anticipated challenges were around poor student compliance (getting them

251 to engage and accept the approach) which in the context of clinical skills teaching would  
252 mean that *“the content has to be repeated before starting the planned practical.”* Some  
253 institutional challenges were identified including curriculum integration, allocating time in  
254 the timetable, and faculty buy in, time, and training. A couple of concerns specific to clinical  
255 skills were that the flipped material must not be seen as an alternative to the practical and  
256 there was a risk that during self-directed learning students *“might develop bad habits”*.

257 *iii) Were familiar with the term ‘flipped classroom’, were not using it in teaching but would*  
258 *consider using the technique prior to teaching in a clinical skills laboratory in the future*

259 Suggested ways that flipped classroom could be used prior to practicals in the clinical skills  
260 laboratory were similar to those mentioned by the other groups; several emphasized that  
261 the activity should be brief and include *“short online videos”, “nanolectures”, and “short*  
262 *quizzes”*. The proposed benefits focused on the students with the flipped classroom serving  
263 to *“de-mystify expectations”* and students being able to *“hit the ground running”* so that  
264 during the practical *“students would get greater opportunity to work on their weakest*  
265 *areas”*. The challenges also focused on students and their (lack of) engagement with the  
266 material and the consequences *“if students don’t ‘show up’ to the webinar they will not*  
267 *know enough to get the most out of the practical session.”* Other potential issues raised  
268 related to the time requirements for students and instructors (creating and *“policing”* the  
269 flipped classroom).

270 *iv) Were not familiar with the term ‘flipped classroom’ before starting the survey but would*  
271 *consider using the technique prior to teaching in a clinical skills laboratory in the future*

272 Participants described similar techniques for the flipped classroom to other groups (videos,  
273 etc.) as well as mentioning specific skills e.g. *“ophthalmology”, “blood smear”, “basic*  
274 *surgery”*. The potential benefits were also similar, focusing on student preparation and time  
275 in the class *“for practical performance and deliberate practice”* allowing instructors to *“focus*  
276 *their time on targeted teaching”*. One of the main expected challenges was around student  
277 engagement whether due to their attitudes or time and subsequently being *‘likely to fall*  
278 *behind in class’* if they did not complete the preparatory assignments. Some also anticipated

279 that the time demands associated with the flipped classroom model could be an issue e.g.  
280 *“it will take a lot of time to prepare these classrooms”*.

## 281 **DISCUSSION**

282 The survey has enabled us to gauge the extent to which flipped classroom techniques are  
283 being used prior to teaching in clinical skills laboratories as well as to identify some of the  
284 benefits and challenges in adopting the approach. The study is timely as more and more  
285 veterinary clinical skills laboratories are opening around the world and the associated  
286 teaching is increasingly embedded in modern curricula. There is an opportunity for the  
287 clinical skills community to embrace the flipped classroom and design effective learning  
288 activities for students to complete prior to arriving at a practical.

289 The results indicated that most of those involved in clinical skills teaching were familiar with  
290 the term ‘flipped classroom’ and just under half were already using it prior to teaching in a  
291 clinical skills laboratory, while most of the rest would consider doing so in the future. The  
292 participants were in general agreement about the benefits, whether anticipated or based on  
293 experience. Although our focus was on using flipped classroom prior to clinical skills  
294 practicals, the findings were similar to those of others in veterinary medicine (Matthew et  
295 al., 2018), including when used in the context of professional skills (Moffett & Mill, 2014)  
296 and preclinical science (Dooley et. al., 2018). It can also be argued that the flipped  
297 component is a more appropriate setting for knowledge acquisition because it allows the  
298 practical to be focused on the actual skill. Students and instructors can then make more  
299 efficient use of their time, with the students more able to engage, ask relevant questions,  
300 and make use of the expertise of the instructor. The instructor benefits from more time for  
301 direct instruction and feedback and to provide additional support to those in need. Time in  
302 clinical skills practicals should optimize the opportunities for practice as skills acquisition  
303 depends on repeated deliberate practice with feedback (Ericsson, 2004; McGaghie et al.,  
304 2010). A widely accepted approach used in clinical skills teaching is George and Doto’s  
305 (2001) five-step technique; the preparatory materials in the flipped classroom would align  
306 with, and potentially address, several of the steps. For example, Step 1 ‘conceptualization’  
307 could be covered by an explanation of the significance to the skill while Steps 2 and 3  
308 (‘visualization’ and ‘verbalization’) can be demonstrated in a video by an expert performing  
309 the skill. The five steps should still form that basis of teaching in the practical, but students

310 can focus their attention and questions and would be more prepared for Steps 4 and 5  
311 practicing the skill followed by opportunities for correction and reinforcement.

312 The challenges our survey participants listed could be considered as major barriers and are  
313 well recognized by others who have studied educators' skill and mindsets as they approach  
314 adoption of the flipped classroom (Wang 2017; Ertmer 1999; Ertmer 2005). The time  
315 commitment from busy faculty to develop the materials can be significant while also  
316 ensuring the design and content will promote the desired learning – that is, if the students  
317 complete it. Although the use of technology has been identified as a barrier in the past  
318 (Rienties et al., 2013; Moffett 2015; Wang 2017), this was not a major finding in our study  
319 which could indicate improvements in usability and/or improved IT skills amongst faculty.  
320 Although the flipped classroom does not entirely depend on technological approaches  
321 (Matthew et al., 2018), removal or reduction of such barriers to implementation is likely to  
322 enable greater adoption of the approach.

323 The issues around students who have not done the flipped classroom materials are well  
324 recognized by others (Radunovich & Acharya, 2018; Akcayir & Akcayir, 2018). In the  
325 literature the flipped classroom material is often referred to as homework, implying that the  
326 work is to be done after class. In the case of a packed veterinary curriculum, this evening or  
327 weekend work can compete with other demands on student time. One potential solution is  
328 dropping the term 'homework' and changing the expectation of when the work is done. The  
329 flipped material would be assigned a slot in the student timetable in the week prior to the  
330 face-to-face class. Such an approach would give students protected time to do the work and  
331 would send a message to students and faculty that the flipped classroom is recognized as a  
332 core activity. Students would then be more likely to engage, and the time faculty spend  
333 preparing the flipped material would be given the same priority and emphasis as other  
334 learning materials.

335 Alternately, curricular and cultural shifts that replace the notion of homework as something  
336 to be done after class with the idea of *preparatory work* necessary to take full advantage of  
337 the affordances of valuable class time could alleviate some of the challenges. In some  
338 instances, participants indicated that students were not allowed to attend if they had not  
339 completed the flipped components. Several individuals also reported concern over the  
340 institution supporting their decision to send students home if they were unprepared for the

341 practical. Realistically, it is more likely that instructors will be faced with finding a way to  
342 catch students up during the practical or deal with two groups, prepared and not prepared.  
343 This is particularly true in the context of clinical skills where some participants quite rightly  
344 raised issues around safety and animal welfare. To mitigate risk to both students and  
345 animals, students need to come prepared to class. A way of ensuring their preparation  
346 would be to make it compulsory, monitored and requiring a specific pass rate on an  
347 assessment based on the preparation material prior to the start of the practical.

348 The overall need for institutional support was clearly presented by participants. They noted  
349 that faculty not only needed time and training to develop and maintain high quality  
350 materials, but also that their institution's administration and their colleagues needed to  
351 clearly buy in to the shifting pedagogical approaches of flipping one's classroom.

352 Participants shared the notion that the flipped classroom was an investment of time and  
353 resources, but overall, worthwhile in terms of results if students come prepared. Eventually  
354 it is anticipated there would be a change in the culture and expectations that would mean  
355 engaging with flipped classroom became the 'norm'. This would involve a better  
356 understanding of the approach and the benefits by students and faculty, embracing the  
357 pedagogy within the curriculum and by the institution, and ongoing research to evidence  
358 the benefits (Chen et al., 2018; Dooley et al., 2016).

359 The limitations of the study include that the participants may not be representative of  
360 broader views as just over half were from USA and UK and the survey was sent out through  
361 networks already known to the authors. However, responses were received from 22  
362 countries and there was an overwhelming engagement in the potential of the flipped  
363 classroom approach. Despite the overall positivity and keenness to utilize flipped classroom,  
364 caution should be exercised as there is currently limited and somewhat ambiguous evidence  
365 of the benefits on student learning in the context of clinical skills (Chen et al., 2018).

366 Therefore, it is proposed that future work should focus on evaluating the impact of flipped  
367 classroom, for example with an OSCE used to measure the effect on subsequent skill  
368 development.

369 In conclusion, the flipped classroom has great potential to enhance student learning in a  
370 clinical skills laboratory. There is widespread interest in embedding the associated  
371 techniques such as videos, short presentations, reading material, and quizzes as required

372 preparation prior to the face-to-face practicals. Educational changes should be based on  
373 established theories and practical evidence that support veterinary students in a  
374 professional program as adult learners. The flipped classroom supports self-directed  
375 learning and allows students to serve as agents on their own behalf as they complete  
376 preparatory work for practicals on their own terms (Knowles, 1980). Offering learners well-  
377 produced materials in different mediums gives them an opportunity to self-direct their  
378 preparation and in a way that is personally meaningful (Moffett, 2015). The flipped  
379 classroom connects with Bloom's Revised Taxonomy (Krathwohl, 2002), allowing educators  
380 to use time outside of class for lower-level cognitive work and reserve in-class time for  
381 application of information and improving students' skills through expert feedback. Though  
382 the flipped classroom takes time to thoughtfully set up – and is often a learning process  
383 where materials must be revised several times along the way before they can be finalized –  
384 the potential of the model is considerable. However, the challenges around time and  
385 engagement should not be underestimated and addressing these issues should form part of  
386 the approach adopted by the clinical skills community and their institutions.

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#### 390 **NOTES**

- 391 a. Qualtrics Survey Software [www.qualtrics.com](http://www.qualtrics.com)
- 392 b. Network Of Veterinarians In Continuing Education (NOVICE) [www.noviceproject.eu](http://www.noviceproject.eu)
- 393 c. International Veterinary Simulation in Teaching (InVeST) [www.vetedsimulation.com](http://www.vetedsimulation.com)

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