Implementation of a Blended Learning Module to Teach Handling, Restraint, and Physical Examination of Cats in Undergraduate Veterinary Training

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ABSTRACT

Cats can be easily stressed in a clinical (training) setting and may show unpredictable reactions and patterns of defensive aggression. This can be a complicating factor in undergraduate veterinary training. Inexperienced veterinary students can evoke defensive feline behavior that negatively affects learning outcomes and animal welfare. As a result, restraint techniques and physical examination of cats was hardly practiced in pre-clinical training at Utrecht University. To overcome this, a new blended learning module was developed using a lecture on feline behavior; e-learning modules about feline behavior, handling, restraint, and physical examination skills; and redesigned practical sessions in which live animals and manikins were used. The aim of this study was to investigate how students' perceptions of competence and confidence changed regarding feline behavior, handling, restraint, and physical examination skills after the new module was implemented. Questionnaires were used for quantitative analysis, and focus groups were used for qualitative analysis. The results show that compared with students who followed the standard module, students who participated in the blended learning module scored higher in feeling confident with handling animals, feeling competent to perform physical examination on cats, and ability to assess whether a cat is stressed. Students with less experience with cats were more likely to show improvement in assessing a cat's stress level than students who had much experience with cats. The results demonstrate that the blended learning module improves students' learning outcomes regarding feline skills training and adds to reduction, refinement, and replacement of the use of live cats.

Key words: e-learning, feline manikins, stress-free handling cats, animal welfare, student evaluation, feline physical examination, Bachelor of Veterinary Medicine

INTRODUCTION

Veterinarians need extensive skills in handling, restraint, and physical examination with a variety of animal species. Training in these skills is an important aspect of undergraduate pre-clinical veterinary training.

In 2014 in the Netherlands, there were 2.6 million cats and 1.5 million dogs.[1] Therefore, in companion animal practice, veterinarians need special skills to handle and examine cats. Cats are not small dogs; they differ in cooperative behavior and physical characteristics. At Utrecht University, animal handling, restraint techniques, and physical examination of companion animals, horses, and farm animals are part of the first year of the veterinary undergraduate program. However, training students in these skills for dogs, for instance, exceeds the training for cats due to differences in their behavior. Cats are easily stressed in a clinical training setting and may show unpredictable reactions with patterns of fear-induced defensive aggression.[2] During yearly course evaluations, students mentioned this lack of training and requested educational adjustments correcting this discrepancy.

Practicing handling and restraint techniques in cats will result in cats' behavioral and physiological stress responses, and repeated aversive handling compromises animal welfare.[2,3] For instance, cats in full-body restraint struggle significantly more often than cats in passive restraint, clearly showing their discomfort. Additionally, full-body restraint significantly influences certain clinical parameters, resulting in less reliable examination results.[2] Fear and stress in cats may cause offensive and defensive aggressive behavior, which impairs students' learning experience and may even inflict potentially severe wounds to students and teachers.[4] Training these skills using live cats is thus under debate. While the use of live animals may provide students with the most realistic experience, unexperienced handling has clear disadvantages, and Russel and Burch's principle of the 3Rs (replacement, reduction, and refinement) should be applied to animals used for educational purposes.[5]

It is important to ensure that students are well prepared before they handle live animals in practical sessions. For this purpose, several training methods have been described, using, for instance, computer-assisted learning, animal models, and e-learning.[6–12]

It is valuable for students to have access to an online learning environment with footage that demonstrates the handling, restraint, and physical examination techniques before practical sessions. Ample evidence shows that blended learning or flipped classroom learning, in which online training is used as preparation for face-to-face learning, is an effective approach that significantly enhances students' performance and perceived confidence at learning skills in health professions, including veterinary medicine.[13–15]

Artificial animal models can be used instead of live animals for training skills that cause animals discomfort. Several studies have described the use of artificial animal models in blended learning modules in which live animals could not be used for practical and ethical reasons.[16–18] Using models for skills training has been shown to improve students' skills and self-confidence.[6,9,19,20]

Training models have several pedagogical advantages for increasing self-confidence in students. The use of manikins creates a stress-free learning environment that gives students ample time to practice and receive feedback from educators.[21–23]

At Utrecht University, students indicated that skills training in handling and examining cats was insufficient, and they felt ill-prepared to perform a physical examination on feline patients during their clinical rotations. Teachers were reluctant to expand the exposure to live cats, however, due to the aforementioned negative experiences. When feline manikins became available and low-stress handling techniques for cats were propagated, we decided to adjust our feline skills training.[3,24]

We developed a new blended learning module for training feline handling, restraint, and physical examination skills, making use of, among other things, e-learning and feline manikins. The aim of this study was to investigate how students' perception of competence and confidence changed regarding feline behavior and handling, restraint, and physical examination skills after implementation of the new module. In this study, we compared a cohort of students following the new blended learning module and a similar sized cohort of students following the standard module in the previous academic year. We used both quantitative and qualitative data on first-year students' perceptions of competence and confidence regarding feline behavior and their feline handling, restraint, and physical examination skills.

MATERIALS AND METHODS

Blended Learning Module Design and Standard Module Design

This cohort study with historical control used two cohorts of 225 first-year Bachelor of Veterinary Medicine students in 2017–2018 (control cohort [CC]) and 2018–2019 (blended learning cohort [BLC]). A power analysis was performed[25]; a sample size of 63 students per cohort was needed ($SD = 1$, power = 80%, and confidence interval = 95%) to significantly demonstrate a change of 0.5 points of the mean Likert score.[26] This is 28% of each cohort of 225 first-year students.

The students in the CC participated in the standard module, in which feline training consisted of a 45-minute small-group (15 students) demonstration of feline handling and restraint techniques using live cats and a 45-minute small-group practical session training feline general physical examination using live cats. The students in the BLC participated in the blended learning (BL) module, which was designed according to the format used for training skills in handling, restraint, and physical examination in other animal species at our faculty. First, students attended a 45-minute lecture on feline behavior and stress signals. Next, they watched a 2-hour e-learning module with text and footage addressing three topics: (a) feline behavior and communication, (b) cats' stress and fear signals in a clinical setting, and (c) low-stress handling techniques and restraint techniques for cats.

In the design of this e-module, the techniques provided by Yin[24] and Herron and Schreyer[3] were used and adapted. The e-module included a self-assessment quiz with automatic check for answers, and students needed to study the e-module as preparation for a redesigned small-group (15 students) 2-hour practical session. This session consisted of a demonstration and discussion on feline behavior and stress signals followed by a practical session on low-stress handling, first using feline manikins and then using live cats. Restraint techniques were only practiced on feline manikins. A 1-hour e-learning module

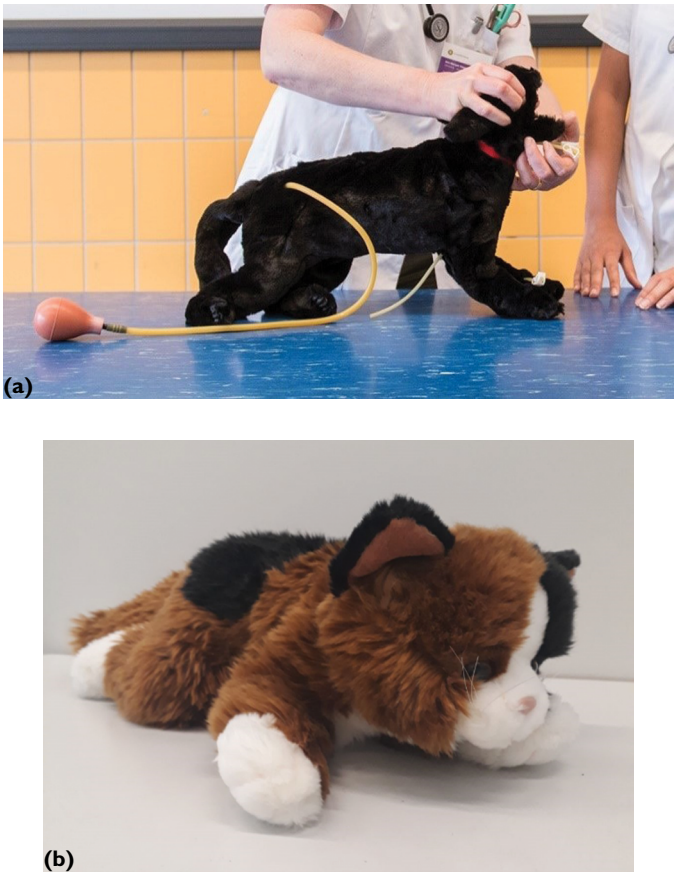

Figure 1: (a) Anatomically correct multipurpose feline manikin used for training feline handling and clinical examination; (b) plush cat used for training feline handling and restraint

with text and footage demonstrating the different components of the feline general physical examination (breathing, pulse, temperature, etc.) on live cats and/or feline manikins was used as preparation for a 45-minute small-group (15 students) practical session on feline general physical examination. The content of this session was comparable to that of the CC, but students were now able to prepare this session using the e-module and could use feline manikins instead of live cats for training skills that are stressful (e.g., opening the mouth). Two types of feline manikins were used: plush cats and anatomically correct multipurpose manikins that were especially designed for veterinary skills training (Figure 1).[27,28]

Data Collection

Quantitative Study Design

Two questionnaires (online-only Appendix) consisting of 5-point Likert-style questions were developed using questions based on recent studies describing innovative approaches in veterinary education.[6,7,9] The start questionnaire consisted of 36 questions, and the same 36 questions (minus 2) supplemented with 25 questions about the content and effect of the BL module were included in the end questionnaire. About 10 minutes were required to complete each questionnaire. The concept questionnaires were reviewed and optimized using feedback from veterinary students, teachers, non-experts, and external educational experts. The questions were classified per topic: previous experience with cats, knowledge of

feline behavior and stress signals, emotional perception and self-confidence around animals and in particular around cats, expectations and concerns regarding handling and examining cats, and preparedness for future education. The start questionnaire was designed to determine base levels and was submitted online at the beginning of September 2017 (CC) and September 2018 (BLC).[29] The end questionnaire was submitted at the end of May 2018 (CC) and May 2019 (BLC). Students were informed about this study during a lecture and encouraged to participate, and they were reminded twice via email. As incentive, a chocolate bar was raffled among every 25 participants.

Qualitative Study Design

An open question was added to the end BLC questionnaire, inviting students to voluntarily participate in focus groups to discuss their experiences in the BL module. Two focus groups were designed following Dooley et al.[13] and Kitzinger.[30,31] The number of students per focus group was selected based on students' availability. Every student signed an informed consent form before taking part in the focus group, and responses were kept anonymous. As incentive, the participating students were given a chocolate bar at the end of the session. In the focus group sessions, the interviewer submitted a limited number of open questions using a semi-structured approach (see online-only Appendix 2). The questions were defined based on the qualitative study, specifically designed to gain information on the different elements and the effectiveness of the BL module. In the focus groups, everyone was able to speak until no new information came up.[30–33]

Ethical Approval

This study was approved by the ethical review board of the NVMO (Dutch Society for Medical Education), NERB dossier number 931. Students were invited to voluntarily participate in the study. All participants approved the use of their anonymized data. Personal information (email address) was only used to link the start questionnaire to the end questionnaire and for giving out the incentives. Afterward, the data was coded and personal information was discarded.

Data Handling

Students who had already participated in a veterinary study program, either in the Netherlands or in another country, were excluded from data analysis. Students under age 18 were also excluded since no ethical consent was requested for this age category (online-only Appendix 1: Qs 2–5). During the study, we decided that expanding the study with a qualitative analysis would enhance the quality of feedback regarding the content and effect of the BL module. Several questions from the questionnaires were used to design the questions of the qualitative analysis, and these data were not used in the quantitative analysis (see online-only Appendices 1 and 2). Within the start and end survey, several questions were seemingly equivalent. Analysis of questions that are seemingly alike would not result in extra information; thus, for data analysis, representative questions were selected based on clear formulation and clear connection with the aim of the study (see online-only Appendix 1). Question 15—"I am afraid of cats"—was reverse coded to "I am not afraid of cats" during data processing (see online-only Appendix 1). This way, in all questions, an ascending scale always presented an increasing agreement. Finally, 11 questions were selected for analysis; these questions are bolded in Appendix 1 (online only).

Explanatory Variables

Question 6, "I intend to choose the following master's program," was coded into a binary variable *master track*. Students who opted for the companion animal health (CAH) master track fit into the *companion animal* reference category. Students in the *other* category opted for equine health, farm animal health, or other (see online-only Appendix 1).

Question 26, "In the past year I have had (daily, weekly, monthly, yearly) contact with cats," was coded into a binary variable *contact with cats*: students who had daily or weekly contact were included in the *high* category; students who had contact monthly or yearly were assigned to the *low* category (see online-only Appendix 1).

Data Analysis

Quantitative Analysis

Data from the questionnaires were retrieved from the survey program SurveyMonkey®.[29] Results of the questionnaires are presented as a 5-point Likert scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *partially agree*, 4 = *agree*, 5 = *strongly agree*). Each of the 11 selected questions was analyzed separately. Data were summarized and presented by cross tables, means, and standard deviations per cohort and moment. The independent sample Mann–Whitney *U* test was used to compare the start and end results between both cohorts and to compare the start and end results within each cohort to determine whether the data were of similar composition (also known as the test to compare the median value).

Next, the questionnaires of individual students who had completed both start and end questionnaires were matched and analyzed to determine whether there was a rating improvement within the same student. If a student gave a higher score at the end than at the start within the same question, an *improvement of rating* was coded; otherwise, no improvement of rating was coded. In the matched questionnaires, the change in individual scores for each question separately were compared between the two cohorts using a binary logistic regression. The outcome variable *improvement of rating* was analyzed with the following explanatory variables: *cohort*, *contact with cats*, and *master track*. The variable *cohort* remained in the model at all times, regardless of significance, to answer the research question. The results of the logistic regression analyses were presented as odds ratios and 95% confidence intervals. The Akaike information criterion was used to select the best model. The change of the estimated coefficient β (> 15%) was studied for confounding when a variable was removed. The program R version 3.6.0 was used to analyze the data.[34]

Qualitative Analysis

The focus groups were recorded using a voice-recorder, saved as mp4 files, and transcribed using NVivo Transcription.[35] Data were coded and specified into themes using an inductive approach.[32]

RESULTS

Quantitative Results

In the CC (225 students), the start questionnaire had 137 respondents, of which 126 (14 males and 112 females) questionnaires were complete. Of the 112 end questionnaires, 102 (14 males and 88 females) were complete. In the BLC (225 students), the start questionnaire had 146 respondents; 135 (23 males and 112 females) questionnaires were complete. The end questionnaire was completed by 60 out of 61 students (3 males and 57 females). Calculations were made using only the complete questionnaires,

but 61 questionnaires of the end BLC were analyzed to include as much data as possible from that cohort, except for the questions one student did not respond to. In the matched scores within student analysis, only the students who completed both questionnaires were used. The variable *gender* was not analyzed because the male/female ratio was skewed.

Table 1 presents the summary of the students' responses to 11 selected questions as percentages per Likert score and mean Likert scores for the CC and the BLC at the start and end of their first year of study.

No difference was observed between the cohorts in the agreement scores in any of the 11 selected questions at the start questionnaires, meaning both cohorts were similar in their agreement scoring on each of the selected questions.

At the end of the year, students in the BL cohort considered themselves more competent than they were at the beginning of the year to perform a physical examination of cats (Q21), better able to assess whether a cat is stressed (Q22), and less concerned about hurting a cat during the practical sessions (Q33). They were more afraid of cats (Q15) and more concerned about being wounded by a cat during the practical sessions (Q34). Students felt less confident in dealing with cats (Q18) and in handling animals in general (Q11), and they felt less prepared for feline skills training in their next year (Q29).

In the CC, students scored lower on confidence in handling animals (Q11), felt themselves to be less capable of handling cats (Q20), and felt less prepared for feline skills training in the next year (Q29) at the end of the year than at the start. In the CC, the mean end score on the questions was not significantly higher compared with the mean start score for any of the questions. At the end of the year, BLC students were significantly more afraid of cats (Q15), were more concerned about being wounded by a cat during the practical sessions (Q34), and considered themselves better able to assess whether a cat is stressed (Q22) compared with CC students.

The increase in Likert score agreement by students who completed both questionnaires are summarized and presented in Table 2. The BLC was compared with the CC for 11 selected questions. An improvement in rating at the end of the BLC was more likely in 6 of the 11 questions (OR > 1.4) The association was significant (the confidence interval for the odds ratio does not include unity [OR = 1]) in the questions "I feel confident in handling animals" (Q11), "I feel competent to perform a physical examination on cats"(Q21), and "I can assess whether a cat is stressed" (Q22). In the BLC, 21.2% of students felt more confident handling animals (Q11) versus 6.2 % of students in the CC. In the BLC, 53.8% of students felt more competent to perform a physical examination on cats (Q21) versus 34.6% in the CC. In the BLC, 59.6% of students considered themselves better able to assess whether a cat is stressed (Q22) versus 27.2% of CC students. Students also felt better able to assess feline behavior (Q13), felt more capable of handling cats (Q20), and worried more that a cat would hurt (scratch or bite) them during the practical sessions (Q34), but these results were not significant.

Students who opted for the CAH master track were less likely to increase their scores at the end than students who opted for the other tracks on the question "I expect to often have high exposure to cats in my future veterinary profession" (Q28). The baseline score in the CC was 3.12 for *other* and 4.60 for *CAH*, and in the BLC it was 3.30 for *other* and 4.67 for *CAH*. Students who often had contact with cats showed significantly less improvement compared to students who did not often have contact with cats, in the improvement score on being prepared for next year's education considering cat handling skills (Q29). The baseline score in the CC was 3.43 for occasional contact and 3.98 for frequent contact; in the BLC, it was 3.22 for occasional contact and 3.76 for frequent contact. Students who often came into contact with cats (at least weekly) showed less rating improvement in their presumed ability to assess whether a cat is stressed (Q22) than students with occasional contact with cats (monthly or yearly). The baseline score in the CC was 3.17 for occasional contact and 4.10 for frequent contact, and in the BLC it was 2.87 and 3.67, respectively.

Qualitative Results

Two focus group sessions were held in which the content of the BL module was evaluated. Five students participated in the first focus group and three students in the second focus group. The first focus group session lasted for 68 minutes, and the second was 49 minutes. Overall, the participating students were very satisfied with the quality of the e-learning modules and their use in preparing for the lecture and practical sessions. Students found the lecture about feline behavior and stress signals interesting, and it increased their insight into the subject. Students especially remembered and explicitly mentioned pictures showing feline nonverbal communication. One student mentioned these feline communicative signals and stress signals as the most important thing she had learned in the BL module. Students were surprised to learn that cats in general exhibit a solitary lifestyle.

In the practical session about stress-free handling, students found it useful to see different ways to handle cats, such as distracting them with pheromones or toys and waiting for the cat to climb out of the carrier instead of forcing it out:

> It was nice for me, since I'm not so experienced with cats. This was a nice opportunity to make contact with a cat in a calm way.

Students questioned whether this way of handling cats was realistic:

> It was an interesting way to see how you could deal with cats in your practice. There is a lot you can do to comfort them and make everything go smoother. But I wonder to what extent this is a realistic image.

Feline manikins were used by the students to practice the towel wrap.[36] Students were glad to have seen and practiced this cat-friendly restraint technique. Students were positive about learning feline physical examination on a live cat. The lecturers closely paid attention to cats' moods and gave advice when cats were too agitated. Students pointed out that the examination procedure was somewhat chaotic because the consecutive steps of the physical exam as they learned to do with other animal species could not be followed systematically. It rather depended on the cats' cooperation:

> The consecutive steps were not practiced in the correct order. We did what we could do best at that moment, we practiced the things that bothered the cats the least.
>
> You have to be fast and improvise a little bit. But then you at least know it doesn't always go the way you are taught, and I think it is useful to gain this insight in the examination of cats.
>
> Indeed, the cat decided what could be practiced.

Three students, however, stated that they did not feel completely competent to do a feline physical examination after the practical session was finished. They were therefore glad to have access to the e-modules. After the practical sessions, they could review all the steps of the practical session again and in the correct order.

When asked about the most important thing students had learned in the BL module, several points emerged:

> In fact, if you handle cats in a calm way and don't immediately restrain them so they can't bite anymore, as we do in dogs, they cooperate much easier.

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Table 1: Distribution (percentages) and mean of Likert scores of 11 selected questions per moment (start vs. end) and student cohort (BL vs. control)

	Likert score in BL module (%)					Likert score in control module (%)								
Question*	1	2	3	4	5	1	2	3	4	5	Fisher's exact test difference†	BL mean	Control mean	Wilcoxon test difference†
Q11 Start	0.0	3.7	17.8	59.3	19.3	0.0	0.0	16.4	63.3	20.3	b	3.9	4.0	a, b
End	0.0	8.2	27.9	52.5	11.5	0.0	1.0	41.2	47.1	10.8	–	3.7	3.7	–
Q13 Start	1.5	19.3	37.8	33.3	8.1	1.6	20.3	38.3	31.2	8.6	–	3.3	3.3	–
End	8.2	13.1	31.1	39.3	8.2	2.9	22.5	40.2	28.4	5.9	–	3.3	3.1	–
Q15 Start	0.0	0.0	3.0	27.4	69.6	0.0	0.0	7.0	18.8	74.2	a	4.7	4.7	a, d
End	0.0	3.3	9.8	32.8	54.1	0.0	1.0	2.9	24.5	71.6	–	4.4	4.7	–
Q18 Start	0.0	8.9	26.7	45.9	18.5	0.8	8.6	20.3	53.9	16.4	–	3.7	3.8	a
End	3.3	16.4	31.1	34.4	14.8	0.0	10.8	34.3	37.3	17.6	–	3.4	3.6	–
Q20 Start	2.2	18.5	35.6	37.0	6.7	0.8	17.2	31.2	39.8	10.9	b	3.3	3.4	b
End	6.6	21.3	34.4	26.2	11.5	2.9	23.5	42.2	26.5	4.9	–	3.1	3.1	–
Q21 Start	14.8	37.0	28.9	15.6	3.7	5.5	37.5	34.4	17.2	5.5	a	2.6	2.8	a
End	9.8	16.4	47.5	24.6	1.6	2.9	30.4	44.1	18.6	3.9	–	2.9	2.9	–
Q22 Start	3.0	8.9	45.9	35.6	6.7	0.0	10.9	35.9	43.0	10.2	a, d	3.3	3.5	a, d
End	1.6	1.6	19.7	65.6	11.5	0.0	6.9	35.3	51.0	6.9	–	3.8	3.6	–
Q28 Start	0.0	7.4	23.7	34.1	34.8	1.6	7.9	16.5	37.0	37.0	–	4.0	4.0	–
End	0.0	8.3	18.3	38.3	35.0	0.0	10.8	26.5	30.4	32.4	–	4.0	3.8	–
Q29 Start	0.7	8.1	35.6	40.7	14.8	0.0	5.5	32.3	48.0	14.2	–	3.6	3.7	a, b
End	3.3	13.3	38.3	40.0	5.0	2.0	12.7	38.2	38.2	8.8	–	3.3	3.4	–
Q33 Start	13.3	54.1	24.4	7.4	0.7	20.5	49.6	23.6	5.5	0.8	a	2.3	2.2	a
End	28.3	48.3	11.7	10.0	1.7	19.6	56.9	14.7	6.9	2.0	–	2.1	2.1	–
Q34 Start	20.7	46.7	25.9	6.7	0.0	24.4	50.4	18.1	6.3	0.8	a, d	2.2	2.1	a, d
End	16.7	35.0	21.7	21.7	5.0	23.5	38.2	32.4	5.9	0.0	–	2.6	2.2	–

BL = blended learning

* Q11: I feel confident in handling animals; Q13: I am able to assess feline behavior; Q15: I am not afraid of cats; Q18: I feel confident in dealing with cats; Q20: I feel capable of handling cats; Q21: I feel competent to perform a physical examination on a cat; Q22: I can assess whether a cat is stressed; Q28: I expect to often have high exposure to cats in my future veterinary profession; Q29: I feel prepared for feline skills training in the next year of my study; Q33: I worry that I will hurt a cat during the practical sessions; Q34: I worry that a cat will hurt (scratch or bite) me during the practical sessions.

† a: difference in distribution (Fisher's exact test) or between means (Wilcoxon rank test) between start and end within blended learning; b: difference in distribution (Fisher's exact test) or between means (Wilcoxon rank test) between start and end within control; c: difference in distribution (Fisher's exact test) or between means (Wilcoxon rank test) between BL and control within start; d: difference in distribution (Fisher's exact test) or between means (Wilcoxon rank test) between BL and control within end

Table 2: Improvement in rating (score at end higher than score at start) in 11 selected questions comparing the BL cohort and the control cohort within the same students

		Improvement of rating						
		Yes		No			CI	
Question*	Group	*n*	%	*n*	%	OR†	2.5%	97.5%
Q11	Control	5	6.2	76	93.8	Ref	–	–
	BL	11	21.2	41	78.8	4.08	1.38	13.69
Q13	Control	18	22.2	63	77.8	Ref	–	–
	BL	18	34.6	34	65.4	1.85	0.85	4.05
Q15	Control	5	6.2	76	93.8	Ref	–	–
	BL	3	5.8	49	94.2	0.93	0.18	3.97
Q18	Control	14	17.3	67	82.7	Ref	–	–
	BL	8	15.4	44	84.6	0.87	0.32	2.21
Q20	Control	14	17.3	67	82.7	Ref	–	–
	BL	14	26.9	38	73.1	1.76	0.76	4.12
Q21	Control	28	34.6	53	65.4	Ref	–	–
	BL	28	53.8	24	46.2	2.21	1.09	4.54
Q22	Control	22	27.2	59	72.8	Ref	–	–
	BL	31	59.6	21	40.4	3.97‡	1.87	8.69
	Contact cat§ Low	37	50.7	36	49.3	Ref	–	–
	High	16	26.7	44	73.3	0.35‡	0.16	0.75
Q28	Control	16	19.8	65	80.2	Ref	–	–
	BL	10	19.2	42	80.8	0.93‡	0.36	2.31
	Master track¶ other	19	33.3	38	66.7	Ref	–	–
	CAH	7	9.2	69	90.8	0.20‡	0.07	0.51
Q29	Control	20	24.7	61	75.3	Ref	–	–
	BL	13	25.0	39	75.0	0.95‡	0.41	2.15
	Contact cat§ Low	23	31.5	50	68.5	Ref	–	–
	High	10	16.7	50	83.3	0.43‡	0.18	0.98
Q33	Control	18	22.2	63	77.8	Ref	–	–
	BL	9	17.3	43	82.7	0.73	0.29	1.75
Q34	Control	22	27.2	59	72.8	Ref	–	–
	BL	18	34.6	34	65.4	1.42	0.67	3.02

BL = blended learning; OR = odds ratio; CI = confidence interval; Ref = reference category

* Q11: I feel confident in handling animals; Q13: I am able to assess feline behavior; Q15: I am not afraid of cats; Q18: I feel confident in dealing with cats; Q20: I feel capable of handling cats; Q21: I feel competent to perform a physical examination on a cat; Q22: I can assess whether a cat is stressed; Q28: I expect to often have high exposure to cats in my future veterinary profession; Q29: I feel prepared for feline skills training in the next year of my study; Q33: I worry that I will hurt a cat during the practical sessions; Q34: I worry that a cat will hurt (scratch or bite) me during the practical sessions.

† OR for higher score at end of the module in specific category versus reference category

‡ OR adjusted for the other variable in the model (contacts with cats, master track or cohort)

§ Contact with cats: high = at least weekly; low = monthly or yearly

¶ CAH = companion animal health; other = equine health and farm animal health/public health

One student stated she remembered the sentence "If the cat doesn't want it, don't do it" the most. Overall, students were glad to have learned about feline physical examination. One item in particular stayed with them—namely, the fact that it is possible to examine the cat while petting the cat and speaking to the owner:

> It was very useful they told us that when the cat is on your examination table and you are petting it, you can already feel so much.

One point clearly stood out as missing for the students in the BL module. They felt they didn't learn the basics of handling cats:

> Well, more in general, how do I pick up a cat? That kind of stuff, I never learned that. The lessons were immediately about stress-free handling, but how do I normally handle a cat?

DISCUSSION

In this study, a new BL module regarding feline behavior, cat handling, and feline physical examination skills was evaluated using questionnaires and focus groups. A cohort of students (BLC) who followed this blended learning course was compared to a control cohort (CC) of students who followed the standard course. In the analysis of matched scores within students, compared with CC students, BLC students felt more confident in handling animals, more competent to perform a physical examination on a cat, and better able to assess whether a cat is stressed.

At the veterinary undergraduate program at Utrecht University, cat handling and physical examination skills training have been less addressed due to cats not being as cooperative in a clinical training setting compared with dogs, for example. This BL module was developed to optimize feline skills training while considering Russel and Burch's 3Rs in laboratory animal use.[5]

The mean Likert scores of both student cohorts were comparable in the start questionnaires (Table 1), and differences in the mean scores in the end questionnaires cannot thus be explained as differences between the studied cohorts. We may therefore assume that the aforementioned changes in students' perception of competence and confidence (Table 2) are the result of the new BL module.

Table 1 shows that students in the BLC had significantly higher mean Likert scores at the end questionnaire compared with their scores for the start questionnaire on their feelings of competence to perform a physical examination on cats (Q21) and assessing whether a cat was stressed (Q22). They were less concerned they would hurt a cat during the practical sessions (Q33). This did not occur in the CC, suggesting this improvement of perception of confidence is the result of implementing the BL module. However, the reverse may be that BLC students who are more aware of feline behavior and stress signals worry significantly more about being hurt by cats during the practical sessions (Q34), and are more afraid of cats (Q15), a difference that was not noted in the CC students.

Remarkably, BLC students at the end of their first year of veterinary undergraduate training had a lower mean score in their confidence in dealing with cats (Q18), confidence in handling animals (Q11), and preparedness for feline skills training in the next year of their studies (Q29). For the latter two questions, the CC students also scored lower; they also scored lower on feeling capable of handling cats (Q20). This phenomenon in both cohorts of scoring lower after a year of veterinary training could be caused by what is called the Dunning–Kruger effect, which

denotes that those who are incompetent seem to overestimate their competence and that skilled performers tend to underestimate their performance.[37] It is likely that students who were educated and expanded their knowledge and skills gained a more realistic estimation of their performance and realized that they still had much to learn. In light of this phenomenon, the earlier mentioned elevated mean scores on competence to perform a physical examination on cats (Q21) and assessing whether a cat was stressed (Q22) in the BLC are strong signals that the BL module improved students' outcomes in these areas. The time students spent in the BL module was comparable to the amount of time students spend learning these skills with other animals, and was considerably expanded compared with the CC group. Whether the positive effects of the BLC were the result of the change in content or simply the increase in time spent was not part of the analysis, as no specific question regarding this topic was included in the questionnaire.

It can be debated whether the results of the cohort analysis using mean Likert scores truly represent the development of students' perception on selected questions of the questionnaire. The mean scores are calculated from a 5-point Likert scale, which is an ordinal scale. The response categories have a ranked order, but the intervals between values cannot be presumed equal; therefore, the use of the Wilcoxon rank test can be debated.[38] More importantly, individual results were not truly analyzed when comparing mean scores; individual results could be nullified by each other, and mean scores could have been influenced by students who did not fill in both questionnaires. Therefore, a multivariable analysis for improvement within the student on matched scores of individual students was performed.

In the matched scores analysis within students, improvement in rating was measured and compared between the BLC and CC. BLC students showed a significant increase in agreement in feeling confident in handling animals (Q11), feeling competent to perform a physical examination on cats (Q21), and their presumed ability to assess whether a cat is stressed (Q22) compared with CC students. Students in the focus groups specifically mentioned that one of the most important things they learned about in the BL module was feline behavior and stress signals. Students also improved in their perception of being able to assess feline behavior (Q13) and their feeling of being capable of handling cats (Q20), although this was not significant. We may conclude that the extra lecture and the e-learning module about feline behavior and stress signals, which were especially designed for the BL program, resulted in the desired effect. However, these results could not be extrapolated to the questionnaire item "I feel confident in dealing with cats" (Q18). Some inexperienced students noted in the focus groups that they missed learning about basic cat handling skills in the BL program. Education about feline behavior and stress signals does not automatically result in confidently dealing with cats. On the contrary, recognizing more subtle feline stress signals might result in a more careful approach toward cats, and BLC students worried more about cats scratching or biting them during the practical sessions (Q34). The elements that students in the focus groups mentioned as missing will be included in future improvements of the BL module. Table 1 suggests that students were more afraid of cats (Q15) after following the BL module compared to the CC students who followed the standard module, but this difference was not visible in the matched score analysis. The mean scores on this question were very high to begin with (4.7); most students scored the highest Likert score on this item, and improvement on this question was thus less likely. In the qualitative analysis, none of the students who participated reported that they were afraid of cats, and none mentioned they or other students were hurt by cats during the practical sessions. No further information about this topic was available.

Students' rating on the question "I feel competent to perform a physical examination on cats" (Q21) significantly improved in the BL program. The content of the practical session in physical examination was not much altered, but feline manikins were available, and students could prepare the sessions using the e-module with footage of the complete physical examination of cats. Practicing on manikin cats can enhance student skills, which can result in examining live cats with more confidence. Practicing on live animals is a different experience, however, and students wish to feel the animals react or struggle and note that animal models can never replace live animals completely.[6,39]

The e-learning modules that were developed also enhance students' mode of preparation, aiding in their physical exam competence. Interestingly, in the focus groups, students mentioned the use of the e-learning modules after the practical training as well. They used the modules to verify whether they had performed the techniques correctly and to verify which parts of the physical examination they were not able to perform on live cats during the practical training but were needed for a complete physical diagnostic work-up. BLC students learned to perform a physical examination via an altered stepwise approach, examining only the items that posed the least stress and keeping the most stressful elements of the physical exam for last. This was mentioned in the focus groups as one of the main learning outcomes in the BL project: "The cat decides what can be done," meaning that by handling the animal calmly, one can examine even more than was previous expected. Moody et al.[2] describe that the odds of struggling were significantly greater in cats being completely restrained than in cats being passively restrained. Stafford and Erceg,[40] however, describe the successful use of 10 cats from a research unit in their education program in New Zealand. Students repeatedly practiced removal from carrier cages, restraint, and towel wraps, and the authors claim their animals did not experience stress during these practical sessions, since they are used to this. It remains questionable that no stress was experienced as feline stress signals can be very subtle and researchers might not have been unbiased.[2]

BLC students scored significantly higher on the question "I feel confident in handling animals" compared with CC students. This result was unexpected, as this project was designed to improve feline handling only and not animal handling in general. The focus on this BL project might have enhanced students' focus on the importance of animal handling in general and might have motivated them to study the already-existing e-learning modules on handling other species as well. This was not part of the questionnaires, however, and can thus not be concluded from the analysis.

Two explanatory variables were computed and used in the multivariable analysis. It was not remarkable that students who opted for the companion animals master track (including feline medicine) improved less regarding question 28: "I expect to often have high exposure to cats in my future veterinary profession." These students, both in the CC and in the BLC, had very high baseline scores (4.60 and 4.67) and could thus hardly improve their scores. The variable *contact with cats* was more suitable for exploring the influence of affinity with cats. Students who often encountered cats in daily life showed less improvement in their presumed ability to assess whether a cat is stressed (Q22) and less improvement in feeling prepared for next year's skills

training (Q29) than students with occasional contact with cats. The students' baseline levels in the frequent contact category were higher in both questions, both in the CC and the BLC; these students therefore had less room for improvement. Handling cats in a household setting is different from handling them in an educational setting, but these students understood feline behavior better and were more experienced with handling cats. In the focus groups, students indicated that experienced students are perfect for helping other less experienced students, a practice already common in the equine practical sessions at Utrecht University. Flipped classrooms in veterinary medicine present a perfect opportunity to allow peer teaching and teamwork.[41] This suggestion will be implemented in future improvements on the BL module.

Students could voluntarily sign up for the focus groups—that is, they were not selected. This could have biased the results of these groups, as highly motivated students are more likely to voluntarily participate. Therefore, the answers students gave in the focus groups must not be generalized and were only used to obtain more insight into the BL module. These comments can be used as suggestions to further improvement. Ideally, the number of participants of a focus group should be between 6 and 10 respondents,[42] but these numbers could not be realized in this study as more student volunteers could not be enrolled.

The BLC students' end questionnaire responses dropped considerably compared to the CC due to problems with SurveyMonkey® questionnaires being blocked as spam by university email programs. Considering the power analysis, 63 students minimum were needed to measure a difference in mean scores of 0.5 between the questions in both cohorts. This means that the effects measured in the cohort analysis were indeed relevant, but other less prone effects might not have been found due to the lack of BLC students in the end group.

This study used student perception and self-reported competence and confidence. However, self-reports can either under- or overestimate a student's capabilities.[37] The effect of this BL module could have been examined by measuring student skills on handling and examining cats in an objective structured clinical examination (OSCE).[43] Dooley et al.[13] describe enhanced student satisfaction as well as veterinary students' achievement of significantly higher grades on the final examination in a flipped classroom cohort. However, Moffett and Mill[44] describe students of the traditional education program performing better than students in the flipped classroom on a test, maybe due to the amount of content material that can be covered in a simple lecture compared with during a class of similar length that is more focused on active learning. A review of flipped classrooms' effectiveness in medical education shows that flipped classrooms are at least as effective as traditional education with regard to knowledge and skills and that students generally like flipped classrooms.[45] We used the flipped classroom principle to improve students' learning outcomes regarding feline handling, restraint, and clinical examination. We did not include students' performance in an OSCE in this study because live cats are not used in our OSCE and feline manikins that can be used to test feline handling skills were only available in the BLC.

In this new BL module, fear-free clinic and stress-free handling techniques were implemented via an additional lecture, e-learning, and an adjusted practical module, and physical examination of cats was adjusted using e-learning and feline manikins. Compared with students who learned via the standard module, students who took the BL module reported that their perception of proficiency in the physical examination of cats enhanced and they were better able to assess whether a cat was stressed. We can therefore conclude that the BL module had the aimed-for effect. Further studies using skills testing in an OSCE setting can substantiate this. The ultimate goal of this BL module aims for students to be better prepared to handle and examine feline patients in clinical rotations and thus be better prepared for their career as veterinary practitioners.

CONCLUSIONS

In this study, focus groups and questionnaires were used to investigate the implementation of a blended learning module to feline handling, restraint, and physical examination in undergraduate veterinary training. The quantitative results demonstrated that this BL module improved students' confidence in handling animals, perceived competence in feline physical examination, and perceived ability to assess feline stress signals. Students who had less contact with cats in daily life were more likely to improve their score on the presumed ability to assess whether a cat was stressed. With these results, this BL program at Utrecht University is further improved and now embedded in the school's veterinary undergraduate curriculum.

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