Bridging the Gap:

Exploring Perception Gaps in Dental Veterinary Training and Graduate Preparedness

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1 Introduction

Dr. Mariea Ross-Estrada, a faculty member at North Carolina State University's College of Veterinary Medicine, is exploring whether there are differences between the expectations of small animal primary care veterinary employers and veterinary educators regarding new graduates' competencies in dentistry. Through her own professional experience and conversations with colleagues, Dr. Ross-Estrada observed that many veterinarians must rely on on-the-job training to gain the skills necessary for small animal dentistry. These shared experiences prompted her to investigate whether there is a misalignment between what is taught in veterinary programs and what is expected in clinical practice.

To explore this question, Dr. Ross-Estrada distributed two surveys: one to medical directors and private practice owners, and another to primary care veterinary educators. Both surveys included similar questions about what early-career veterinarians are expected to have learned during their education and the skills they are expected to perform in practice.

This research has the potential to improve veterinary care by ensuring new graduates are better prepared to meet clinical demands. It could also support a smoother transition into practice for early-career veterinarians, reduce the burden of on-the-job training for employers, and promote overall workforce readiness in the field of small animal primary care.

1.1 Research Question

How do small animal primary care employers (medical directors and practice owners) and primary care veterinary educators differ in their expectations of early-career veterinary graduates' competencies in small animal dentistry?

1.2 Statistical Questions

S1. Are there significant differences between educators and practice owners in their belief that new graduates are competent in key dental skills on their first day of practice?

S2. Is there a difference between educators and practice owners in their reports (educators' actual teaching vs. owners' perceptions) of which dental skills were taught in the pre-clinical DVM curriculum?

S3. Is there a difference between educators and practice owners in their level of agreement about whether specific dental skills should be taught pre-clinically?

S4. Do employers and educators differ in their expectations about how many dental procedures new graduates should complete during clinical training?

S5. Is there a difference between the instructional formats in dentistry reported by DVM programs and those perceived by employers to have been completed by early-career veterinarians?

S6. Do educators and employers differ in their views on which formats of clinical instruction in dentistry should be required for DVM students?

S7. Is there a difference between the clinical dentistry skills that educators report DVM students are learning during clinical training and the skills that employers believe recent graduates have completed as part of their DVM program?

S8. Do educators and employers differ in their opinions about which clinical dentistry skills DVM students should be required to practice or learn during their clinical training?

2 Data

2.1 Data Description

Two separate surveys were administered to mutually exclusive groups: veterinary employers who have worked with students and educators who have taught students. There was no overlap between these groups, and they can be assumed to be independent.

The employer dataset consists of responses from 29 participants answering 40 questions, while the educator dataset includes 43 participants answering 34 questions. Each group was asked a single qualifying question to determine eligibility for participation, along with nine questions covering demographics and institutional context. Educators were then presented with 24 competency- and sentiment-based questions, while employers answered 30 such items focused on professional expectations and training in veterinary medicine.

Survey questions took several forms. Some were binary (Yes/No), particularly those related to demographics and institutional affiliation. Others used a "select all that apply" format, commonly seen in questions asking respondents to identify procedures performed at their practice. Many of these were followed by Likert-scale items. The Likert scales were even-numbered and omitted a neutral option, which may have contributed to at least two instances where respondents selected both "agree" and "disagree" for the same item.

Several questions offered an "Other" response with a text box for elaboration. A few required numeric input, such as estimates of hours worked or the number of practicing veterinarians. These integer fields were not restricted by any upper bound, regardless of contextual reasonableness.

Global survey session metrics

Survey completion time differed by group. On average, educators spent more time completing the survey than employers. While no follow-up question asked participants to explain their response time, this discrepancy may reflect greater engagement or a tendency among educators to provide more elaborated responses. It may also suggest a greater willingness to participate thoughtfully. The box plot in Figure 2.1 illustrates the distribution of survey duration (in minutes) by group.

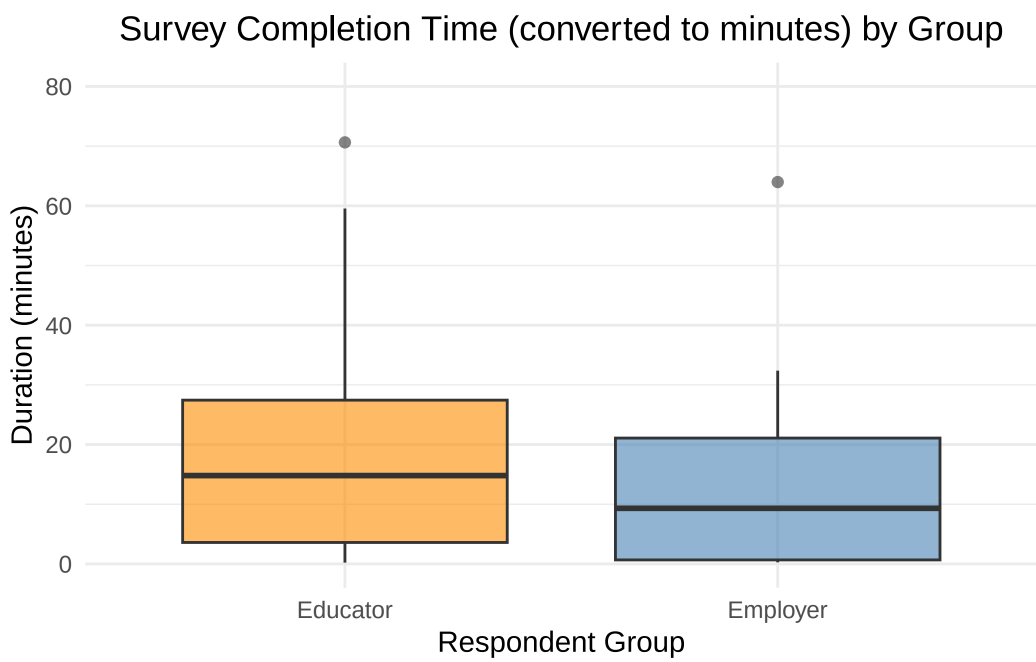

Figure 2.1: Assessing survey elapsed time distribution via box plots to understand engagement by survey group.

Regarding the proportion of the survey completed, employer responses were more variable—spanning the full range from partial to full completion. In contrast, educators tended to complete a greater portion of the survey, with most responses clustering near full completion and a less pronounced left tail. Figure 2.2 visualizes these differences in survey progress across groups.

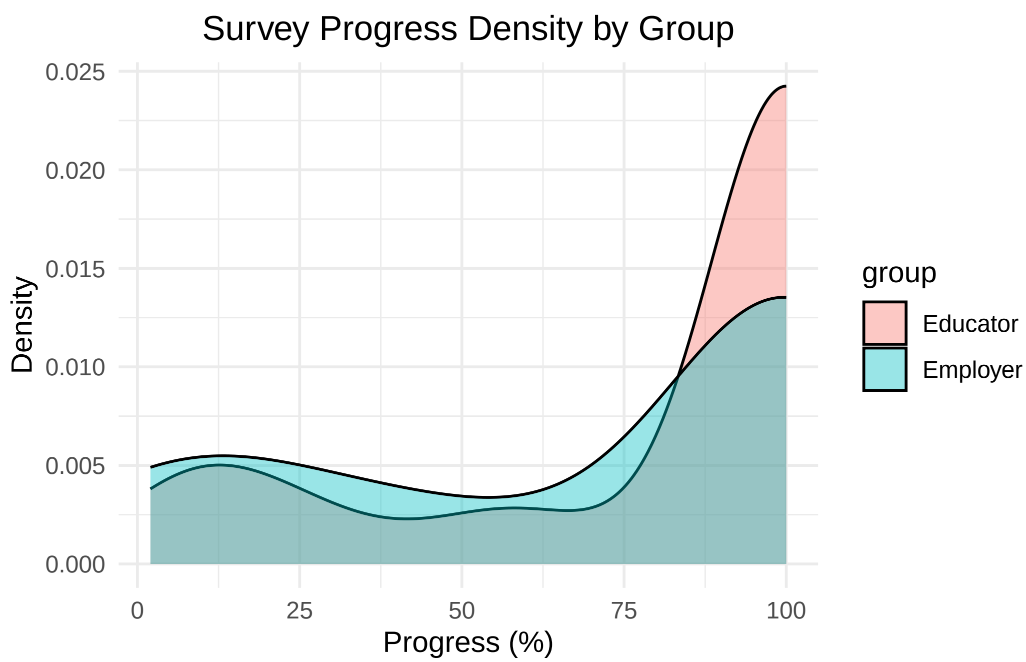

Figure 2.2: Assessing survey completion as a density curve to understand engagement by survey group.

Our analysis focused only on responses from the United States. Using metadata from the Qualtrics survey output, we leveraged geographical data points to remove three responses from the working dataset. Employer survey participants were predominantly sampled from locations along the eastern seaboard, while educators were more widely distributed across the country. We highlight this to illustrate that perceptions of veterinary dental students—particularly among employers—may differ for individuals located far from the regions where most participants were sampled. Additionally, because many responses came from major metropolitan areas, our findings may underrepresent sentiments regarding student knowledge gaps in rural locations. Figure 2.3 visualizes the geographic distribution of participants.

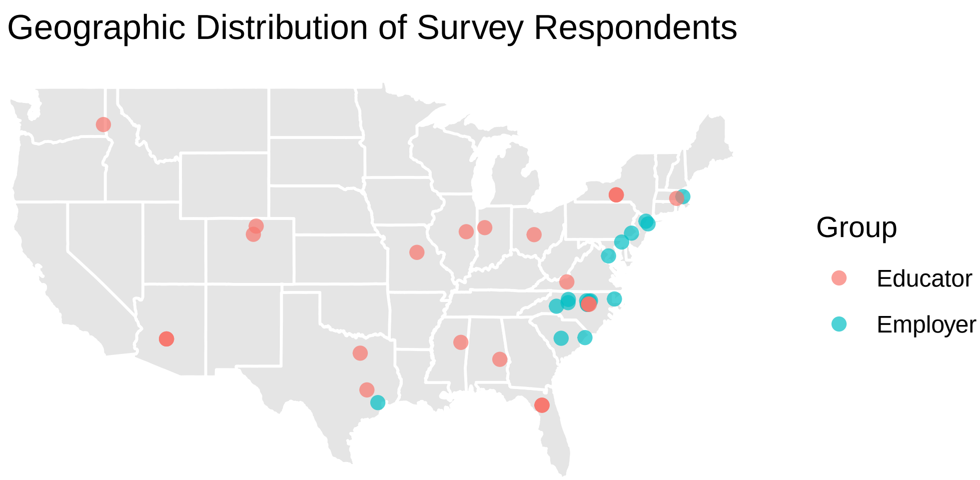

Figure 2.3: Geographic distribution of survey respondents across the United States.

Educator metrics

Figure 2.4 provides an overview of the survey participants and their institutions. Most respondents reported having between two and four years of experience teaching veterinary students in clinical training. The distribution of years taught appears approximately normal, with fewer educators at both the lower and upper ends of the range. Respondents also reported the number of dental procedures performed by their primary care service each week. While some outliers from busier institutions reported higher volumes, most educators estimated performing between one and eight procedures per week.

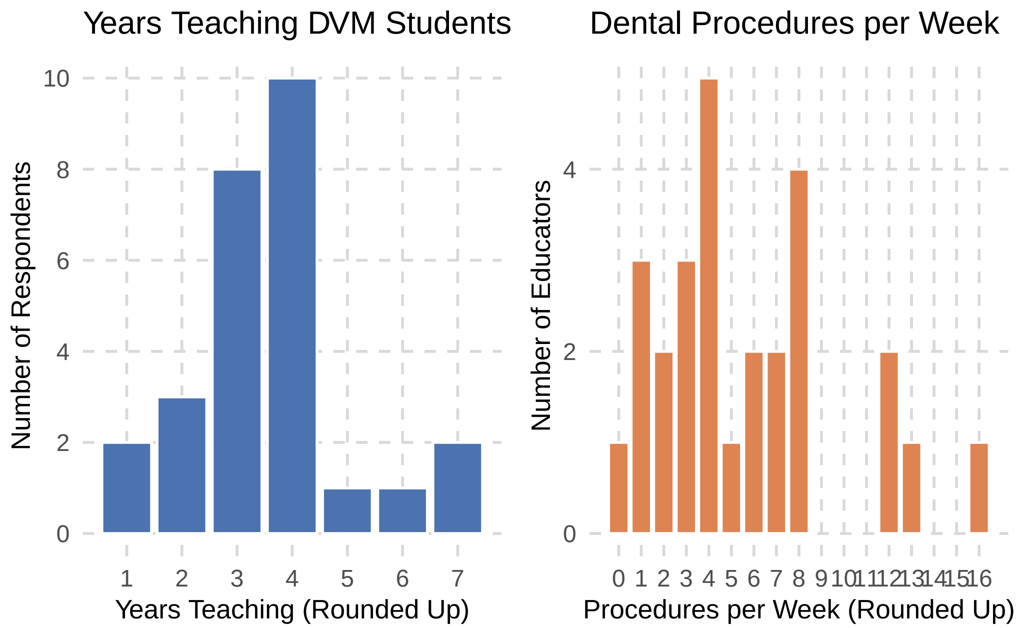

Figure 2.4: Educator contextualized background information about teaching and procedures.

Employer metrics

The employer dataset was considerably smaller than the educator dataset, which may reflect differences in motivation or willingness to complete the survey. Table 2.1 shows the distribution of employer organizational types. Independently owned practices—whether operated by a single practitioner or multiple—comprised 75% of all employer survey participants. This aligns with findings from the American Veterinary Medical Association (AVMA), which reported that “most veterinarians age 75 or younger, 83.9%, work in private clinical practice” (American Veterinary Medical Association, 2019). In fact, the sampling distribution is consistent with national statistics regarding the types of practices in which veterinarians report working.

Another demographic worth highlighting is that survey responses were also heavily skewed toward practice ownership, with 63.6% of employer participants identifying as owners. By comparison, the same AVMA survey reported that only 21.3% of veterinarians identify as practice owners. This discrepancy may be due to the smaller sample size or to the possibility that practice owners were more willing to complete the survey than associates or other veterinary professionals. Table 2.2 provides a breakdown of participants’ reported roles within their practice.

Table 2.1: Job Setting or Organization: Counts and Percentages

Job Setting	Count	Percentage
Group corporate veterinary practice	2	16.7
Independently owned group veterinary practice	2	16.7
Independently owned single veterinary practice	7	58.3
Industry/commercial	1	8.3

Table 2.2: Respondent Role: Counts and Percentages

Respondent Role	Count	Percentage
Associate veterinarian	2	18.2
Practice manager/HR representative	2	18.2
Practice owner	7	63.6

Figure 2.5 shows that procedure counts tend to be lower in the employer group compared to the educator group results presented in Figure 2.4, although the overall distribution shapes are similar. In both groups, the data exhibit a right-skewed pattern, with most respondents reporting lower procedure counts and a few outliers representing higher volumes. This pattern aligns with the intuitive understanding that while some practices or institutions place greater clinical demands on veterinarians, such cases are less common—at least based on the survey responses.

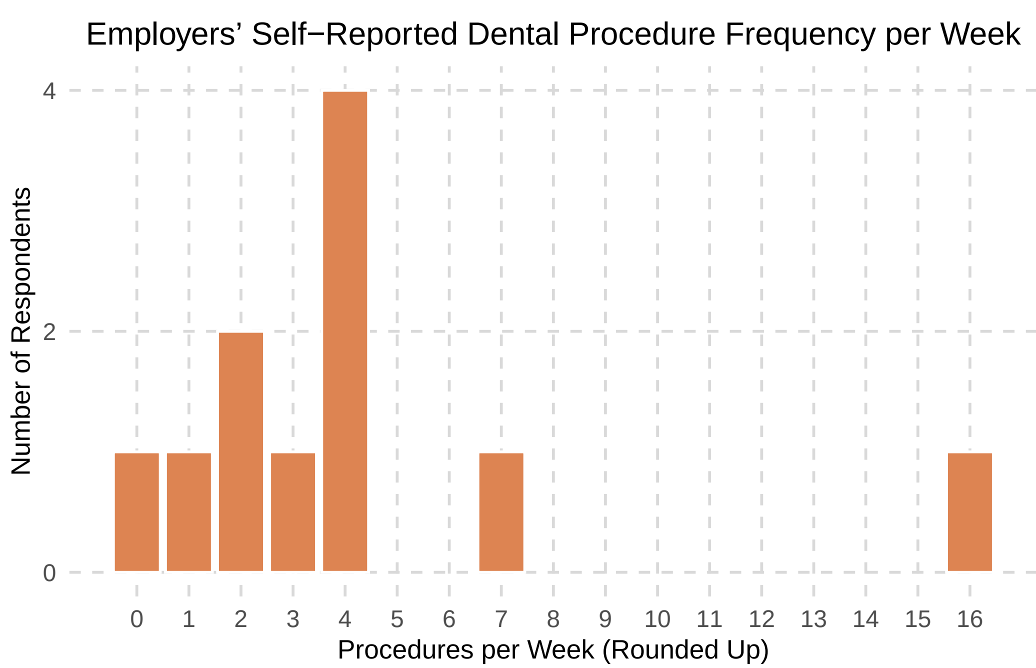

Figure 2.5: Average dental procedures employer survey participants indicated they performed each week.

2.2 Data Source

Survey data were collected using Qualtrics, a cloud-based experience management platform commonly used to gather feedback and sentiment across workforce domains. Participants in the educator survey were recruited via email invitations sent by the researcher using pre-existing contact lists. Dr. Ross-Estrada distributed the employer survey through her personal and professional online networks. Participation was voluntary and anonymous, and no incentives were offered for completing the survey.

2.3 Preprocessing Description

Although the employer and educator datasets shared a similar structure, they were not identical. Most preprocessing steps were applied uniformly across both datasets, with minor deviations where needed.

The datasets were imported into the RStudio environment (version 2024.04.1 Build 748). A new variable was created to label the data source ("Educator" or "Employer") for later grouping and visualization. The existing respondent_id column served as a unique identifier and was treated as the primary key.

Initial cleaning involved removing extraneous metadata included by Qualtrics—such as survey start and end times, IP addresses, geolocation data, and question display logic—all of which were irrelevant to the analysis. These columns were trimmed to streamline the datasets for subsequent transformation and statistical work.

Column names in the original Qualtrics export were alphanumeric but often ambiguous and misleading. Many variable names did not match the corresponding survey question numbers. Our team manually mapped the exported column names to their corresponding survey questions and responses by referencing adjacent metadata fields and using deductive reasoning. This process allowed us to build an index-based column naming structure, which greatly improved the manageability and interpretability of the datasets.

Before diving into question-specific analysis, we first identified the subset of survey questions relevant to our research objectives. All unrelated or out-of-scope items were removed. This step reduced the employer dataset from 176 columns to 100, and the educator dataset from 171 columns to 102.

Several formatting inconsistencies also needed to be resolved. Some multi-select questions appeared as comma-separated text responses within a single column, while others were exported into multiple binary columns. Additionally, for certain questions, response options that received zero selections were dropped entirely by Qualtrics. To standardize these issues, we implemented a script to "explode" comma-separated responses into individual binary columns. For dropped columns, we manually reintroduced them as zero-filled dummy variables to preserve the full response structure.

Finally, we filtered out participants who answered less than half of the survey. We also excluded:

- Employers who responded "No" to the question: "Do you work with early career veterinarians (someone who has graduated from a DVM program after May 2021)?"
- Educators who responded "No" to: "Do you teach in any capacity of the dental curriculum at your institution?"

After all preprocessing steps, the final cleaned datasets consisted of 13 employer participants and 30 educator participants.

3 Statistical Methods

Likert Scale Questions (Statistical Questions #1, 3, 6, and 8)

These questions use a Likert scale with the response options: Strongly Agree, Agree, Disagree, and Strongly Disagree across a variety of skills and procedures. Given the ordinal nature of these responses, we will use diverging stacked bar charts and summary tables to visually explore the data. We will then use Mann-Whitney U tests for formal hypothesis testing of differences between groups. Finally, we will calculate a Ranked-Biserial Correlation (RBC) as an effect size measure to determine the direction and magnitude of differences between groups.

The Mann-Whitney U test is a non-parametric test used to assess whether there is a statistically significant difference in the distributions of ordinal or continuous variables between two independent groups. In this case, educators and employers are assumed to be independent, consistent with the survey design.

This test is appropriate for Likert-scale data because:

- It does not assume normality (unlike the t-test).
- It respects the ordinal (ranked) structure of the data.
- It retains statistical power in small samples.

Table 3.1 provides a summary structure of the ranked outcomes used in the Mann-Whitney U test.

Table 3.1: Mann-Whitney U Rank Summary Table

Group	Sample.Size	Sum.of.Ranks	Mean.Rank
Group 1 (e.g., Educators)	n_1	R_1	R_1 / n_1
Group 2 (e.g., Employers)	n_2	R_2	R_2 / n_2

In order to calculate the test statistic and p-value for a Mann-Whitney U test:

- All observations are ranked together
- The sums of ranks for each group is calculated (R_1 and R_2)
- The test statistic U is then calculated as the minimum of U_1 and U_2 where U_1 and U_2 are the following: $U_1 = R_1 - \frac{n_1(n_1+1)}{2}, U_2 = R_2 - \frac{n_2(n_2+1)}{2}$

- Then the p-value is calculated from the U distribution or normal approximation.

To complement the Mann-Whitney U tests, effect sizes were calculated using the rank-biserial correlation (RBC). While the p-value assesses whether a statistically significant difference exists between groups, the rank-biserial correlation quantifies the magnitude and direction of that difference—adding a layer of practical interpretation. An RBC value near 0 suggests little to no effect, while values near -1 or 1 suggest large differences favoring one group over the other.

Formally, the RBC is calculated directly from the Mann-Whitney U statistic:

$r_{rb} = \frac{2U}{n_1 n_2} - 1$

Where:

- U is the Mann-Whitney U statistic (typically the smaller of U_1 and U_2)
- n_1 and n_2 are the sample sizes of the two independent groups

This formula scales U into the $[-1, 1]$ interval, where:

- $r_{rb} = 0$ implies overlapping ranks (no difference)
- $r_{rb} = 1$ implies every value in group 1 exceeds every value in group 2
- $r_{rb} = -1$ implies every value in group 2 exceeds every value in group 1

U is derived by jointly ranking all observations across groups. The sums of ranks (R_1 and R_2) are then used to calculate:

$U_1 = R_1 - \frac{n_1(n_1+1)}{2}$,
$U_2 = R_2 - \frac{n_2(n_2+1)}{2}$

Then U = min(U_1,U_2), and this value is substituted into the formula for r_{rb}.

P-values and RBC values will be applied to each statistical question listed above in order to formally analyze the data.

Select All That Apply Questions (Statistical Questions #2, 5, and 7)

These questions asked participants to “select all that apply” regarding skills in the pre-clinical curriculum, formats of dental instruction, and skills relevant to clinical training, respectively. We will utilize frequency tables and bar plots to explore the data, and apply Fisher’s Exact Test as a formal inferential procedure to compare the two groups. For questions with numerous response options, dot plots will be used to reduce visual clutter in bar graphs.

Fisher’s Exact Test is appropriate for categorical data with independent samples—in this case, educators and employers. Based on the survey design provided by the client, it is reasonable to assume these two groups are independent. In this context, Fisher’s Exact Test is preferred over the Chi-Squared Test due to the small sample sizes, which do not meet the expected count assumptions required for valid Chi-Squared inference. Table 3.2 provides a summary layout of the 2×2 contingency table used in Fisher’s Exact Test.

Table 3.2: Fisher's Exact 2×2 Contingency Table

Group	Outcome.Present	Outcome.Absent	Row.Totals
Group 1 (ex: Educators)	a	b	a + b
Group 2 (ex: Employers)	c	d	c + d
Column Totals	a + c	b + d	n = a + b + c + d

Fisher's Exact Test operates under the null hypothesis that there is no association between the two categorical variables. The alternative hypothesis is that an association exists. The p-value for the test is computed using the following formula:

$$p = \frac{(a+b)!\,(c+d)!\,(a+c)!\,(b+d)!}{a!\,b!\,c!\,d!\,n!}$$

P-values are then computed for each skill, instructional format, or training element to formally compare responses between the two groups (educators and employers), depending on the statistical question being analyzed.

Numerical Entry Questions (Statistical Question #4)

This question asked participants to enter a number corresponding to how many dental procedures should be completed during training in various areas. We plan to use box plots and/or histograms to visually examine the data. Depending on whether the distributions meet the assumption of normality, we will conduct either a two-sample t-test or a Mann-Whitney U Test.

As mentioned above, the Mann-Whitney U Test is a non-parametric test that does not require the assumption of normality. If the normality assumption were met, a two-sample t-test could be considered for this analysis. However, based on our examination of the data, the normality assumption is not satisfied; therefore, we will proceed with the Mann-Whitney U Test. The test will follow the same method described previously for statistical questions #2, 5, and 7.

4 Results

4.1 S1

Research Question: Are there significant differences between educators and practice owners in their belief that new graduates are competent in key dental skills on their first day of practice?

To assess whether there are differences in perceptions of new graduate competence in dentistry, educators and employers were asked a parallel question (Q4). Employers were asked to rate their expectation that early career veterinarians can competently perform 12 specific dental skills on their first day of employment. Educators were asked to rate whether they believe new graduates can perform those same skills competently. Responses were recorded on a 4-point Likert scale from 1 (Strongly Disagree) to 4 (Strongly Agree).

We used the Mann-Whitney U test to compare educator and employer responses for each skill, as this non-parametric test is well-suited for ordinal data from two independent groups. In addition to p-values, we calculated the ranked-biserial correlation (r_{rb}) to assess effect sizes and provide insight into the magnitude and direction of observed differences. Results are summarized with median ratings for each group, sample sizes, and effect size interpretations (e.g., small, medium, large). Significance stars were added to highlight results below conventional thresholds (e.g., p < 0.05), and results were sorted by p-value to aid interpretation (see Table 4.1).

Table 4.1: Mann-Whitney U-Test Results for Competency Ratings

Skill	Med (Edu)	Med (Emp)	N (Edu / Emp)	P-Value	r_rb	Interpretation
Periodontal probing	4	4	28 / 13	1.000	0.00	Negligible effect
Dental radiography - positioning	3	2	27 / 12	0.369	0.18	Small positive effect
Dental radiography - interpretation	3	3	28 / 12	0.052 .	0.36	Medium positive effect
Scaling	4	4	27 / 13	0.552	-0.10	Negligible effect
Polishing	3	3	28 / 13	0.242	0.21	Small positive effect
Simple extractions - canine	3	3	28 / 13	0.374	0.16	Small positive effect
Simple extractions - feline	3	3	28 / 13	1.000	0.00	Negligible effect
Open extractions - canine (single root)	3	3	28 / 13	0.769	-0.06	Negligible effect
Open extractions - feline (single root)	2	2	27 / 13	0.613	-0.10	Negligible effect
Open extractions - canine (multi-root)	2	3	28 / 13	0.289	-0.20	Small negative effect
Open extractions - feline (multi-root)	1	1	7 / 4	0.778	-0.11	Small negative effect
Fluoride treatment	3	4	2 / 1	1.000	-0.50	Large negative effect

Overall, educators and employers had generally similar perceptions about new graduate competence in most dental skills, with no statistically significant differences observed at the conventional p < 0.05 threshold. However, some notable trends emerged. Dental radiography interpretation showed a borderline significant result (p = 0.052) with a medium positive effect size (r_{rb} = 0.36), suggesting that educators may be slightly more confident than employers in new graduates' ability to interpret dental radiographs. For most other skills, effect sizes were negligible or small, and p-values were well above 0.05, indicating no meaningful differences in perceived competence between groups. In a few cases, such as open extractions (canine, multi-root), employers had slightly higher confidence than educators (small negative effect size), but again, these differences were not statistically significant. The fluoride treatment item had a large effect size, but due to the very small sample (2 educators, 1 employer), it is not meaningful or generalizable.

4.2 S2

Research Question: Is there a difference between educators and practice owners in their reports (educators' actual teaching vs. owners' perceptions) of which dental skills were taught in the pre-clinical DVM curriculum for recent graduates?

To evaluate whether differences exist between DVM educators and employers in their understanding of which dental skills are taught in the pre-clinical curriculum, we analyzed responses to parallel survey questions. Educators were asked to indicate which of seven core dentistry skills are taught as part of their pre-clinical courses (Q12), while employers were asked which skills they believe recent graduates were taught prior to clinical training (Q16). Since the two groups answered different question numbers about the same underlying skills, we first aligned the datasets by renaming employer variables to match educator labels. This harmonization allowed for direct comparison of responses skill by skill across the two groups.

After cleaning and reshaping the data into long format, we filtered out invalid or missing entries and conducted Fisher's Exact Tests for each skill. This non-parametric test is appropriate for evaluating categorical (yes/no) outcomes in small samples, particularly when comparing proportions between two independent groups. Only skills for which both groups provided non-missing responses were included in the final analysis.

Table 4.2: Fisher's Exact Test Results by Skill

Skill	p_value	n_educator	n_employer	prop_educator	prop_employer
Dental radiograph acquisition	0.307	28	13	0.714	0.538
Oral examination and charting	0.399	28	13	0.786	0.923
Simple extraction technique	0.469	28	13	0.750	0.615
Instrument identification and handling	0.732	28	13	0.643	0.538
Dental cleaning (scaling and polishing)	0.742	28	13	0.536	0.615
Local nerve blocks	0.742	28	13	0.607	0.538
Dental radiograph interpretation	1.000	28	13	0.643	0.615

Results are summarized in Table 4.2. Overall, educators and employers showed general agreement about which dental skills are taught in the pre-clinical DVM curriculum, with no statistically significant differences found across any of the seven skills analyzed. Proportions of reported instruction were similar between groups, with slight variations. For example, more educators than employers reported that dental radiograph acquisition and simple extraction techniques are taught, while more employers believed that oral examination and charting and dental cleaning are included. However, none of these differences reached statistical significance, and all p-values were well above 0.05. These findings suggest a shared but imperfect understanding between groups, with minor discrepancies that are not statistically meaningful.

4.3 S3

Research Question: Is there a difference between educators and practice owners in their level of agreement about whether specific dental skills should be taught pre-clinically?

To assess whether educators and employers differ in their beliefs about which dental skills should be included in the pre-clinical DVM curriculum, we analyzed responses to parallel Likert-scale questions: Q13 (educators) and Q17 (employers). Both groups rated the importance of teaching 12 specific dentistry skills using a 4-point Likert scale ranging from 1 (Strongly Disagree) to 4 (Strongly Agree).

Because the data were ordinal and responses came from two independent groups, the Mann-Whitney U test was used to compare educator and employer ratings for each skill individually. This non-parametric test is appropriate for comparing ordinal data between two independent groups, especially when the assumptions for parametric tests may not hold. Ratings were reshaped into long format and analyzed skill-by-skill. The results table presents medians for each group, sample sizes, p-values with significance indicators, effect size estimates (rank-biserial correlation), and an interpretation of the magnitude and direction of group differences. The results of these comparisons are summarized in Table 4.3.

Table 4.3: Mann-Whitney U-Test Results for Pre-Clinical Dentistry Training

Skill	Median Med (Edu)	 Med (Emp)	N N (Edu / Emp)	P-Value	Effect Size r_rb	Interpretation
Open extractions - feline (multi-root)	3	4	17 / 13	0.002 **	-0.60	Large negative effect
Fluoride treatment	1	3	3 / 9	0.013 *	-1.00	Large negative effect
Open extractions - canine (multi-root)	4	4	26 / 13	0.079 .	-0.29	Small negative effect
Open extractions - canine (single root)	4	4	26 / 13	0.084 .	-0.29	Small negative effect
Open extractions - feline (single root)	4	4	27 / 13	0.093 .	-0.28	Small negative effect
Simple extractions - feline	4	4	26 / 13	0.136	-0.26	Small negative effect
Dental radiography - interpretation	4	4	28 / 12	0.164	0.13	Small positive effect
Scaling	4	4	28 / 13	0.403	0.14	Small positive effect
Polishing	4	4	28 / 12	0.480	0.12	Small positive effect
Periodontal probing	4	4	28 / 13	0.599	0.04	Negligible effect
Dental radiography - positioning	4	4	27 / 11	0.726	0.07	Negligible effect
Simple extractions - canine	4	4	28 / 13	0.788	-0.05	Negligible effect

Educators and employers generally agreed on the importance of teaching core dental skills in the pre-clinical DVM curriculum, with most skills receiving high median ratings (4 = Strongly Agree) from both groups. However, statistically significant differences were observed for two skills. Open extractions skill, feline (multi-root) showed a significant difference ($p = 0.002$) with a large negative effect size (r_rb = -0.60), indicating employers placed greater importance on teaching this skill than educators. Fluoride treatment also differed significantly ($p = 0.013$) with a very large negative effect size (r_rb = -1.00), though the very small sample of educators ($n = 3$) limits interpretation.

Several other extraction-related skills showed small negative effect sizes and borderline p-values, suggesting a trend toward employers assigning slightly more importance to teaching advanced extractions pre-clinically, though these differences did not reach statistical significance. For all other skills, differences were negligible or small, and p-values were well above 0.05, indicating broad consensus on their pre-clinical importance.

4.4 S4

Research Question: Do employers and educators differ in their expectations about how many dental procedures new graduates should complete during clinical training?

To assess whether educators and practice owners differ in their expectations for the number of dental procedures students should complete during clinical training, we compared responses from Question 19 of the educator survey and Question 24 of the employer survey. Respondents indicated the number of procedures they believe should be completed in four clinical settings: primary care, dentistry rotations, shelter medicine, and laboratory animal medicine.

Before selecting an appropriate statistical test, we assessed normality using the Shapiro–Wilk test, which indicated that the data were not normally distributed for any group–setting combination (all p-values < 0.05). Given the non-normal distribution and the ordinal or skewed nature of the data, we used the Mann–Whitney U test—a nonparametric alternative to the independent samples t-test—to compare the distributions of responses between educators and employers for each clinical setting. This test is appropriate when comparing two independent groups without assuming normality or equal variances.

Educators and employers showed broad agreement on the number of dental procedures that students should complete during clinical training, with no statistically significant differences across the four clinical settings evaluated. However, a notable trend was observed in the dentistry rotation, where employers had higher expectations than educators (median = 6.5 vs. 4.0), with a borderline p-value ($p = 0.080$) and a medium negative effect size (rrb = –0.39), suggesting that employers may expect more hands-on experience in this setting.

In the remaining settings—laboratory animal medicine, shelter medicine, and primary care—differences in medians were small, and effect sizes were negligible to small, with p-values well above 0.05, indicating no meaningful disagreement between groups. These findings suggest that while general expectations are aligned, employers may place slightly greater emphasis on procedural experience in dedicated dentistry rotations.

The detailed results for each clinical setting are presented in Table 4.4.

Table 4.4: Mann-Whitney U Test: Expected Dental Procedures by Group and Setting

Setting	Med (Edu)	Med (Emp)	N (Edu)	N (Emp)	P-Value	r_rb	Effect Size
Dentistry_Rotation	4	6.5	24	10	0.080 .	-0.39	Medium negative effect
Lab_Animal	0	0.0	16	9	0.222	0.24	Small positive effect
Shelter_Medicine	2	0.0	19	9	0.235	0.27	Small positive effect
Primary_Care	3	4.0	27	10	0.287	-0.23	Small negative effect

4.5 S5

Research Question: Is there a difference between the instructional formats in dentistry reported by DVM programs and the formats perceived by employers to have been completed by early career veterinarians?

Both educators and employers were asked a question relating to the format of instruction during the clinical year.

In Question 20 of the employer survey, participants were asked: "What format of clinical instruction in dentistry do you believe that the early career veterinarians (individuals who have graduated from a DVM program after May 2021) hired into your practice/organization/institution completed as part of their DVM training? Select all that apply."

In Question 16 of the educator survey, participants were asked: "What format of instruction in dentistry does your DVM program provide during the clinical year? Select all that apply."

Because these questions used a "select all that apply" format, respondents could choose multiple answers, meaning percentages do not sum to 100%. Due to differences in sample sizes, results are reported as the percentage of each group (educators or employers) that selected each instructional format.

Educators and employers were also allowed to write in their own responses. One employer entered "Cadaver." Two educators entered custom responses: one mentioned "rounds," and another described "topic seminars [that] occur with some rotations during case rounds when dental cases are chosen to present."

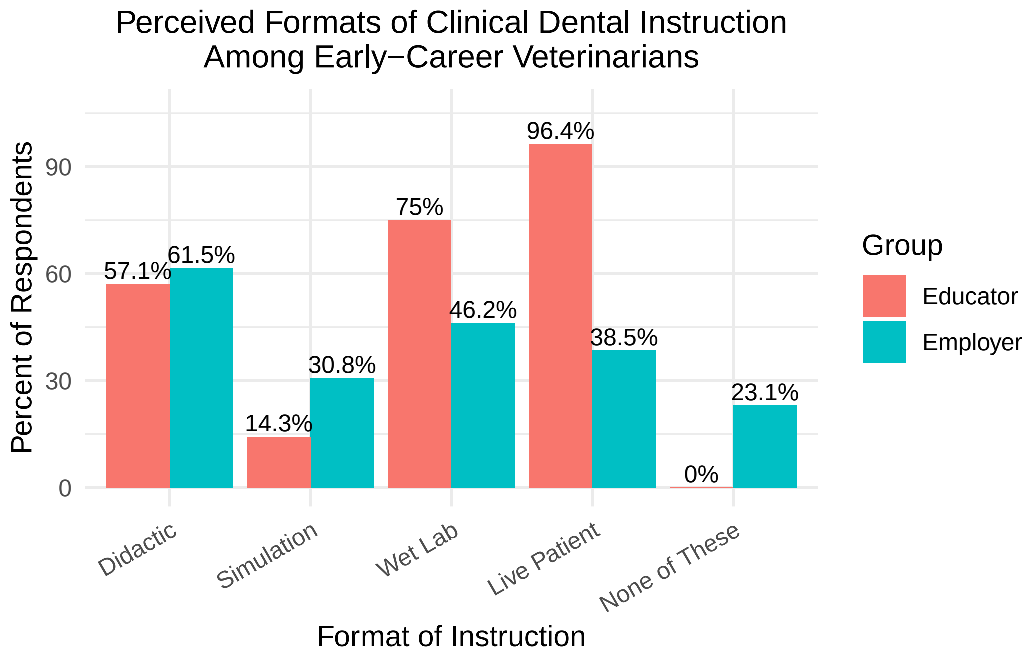

Figure 4.1: Perceived Clinical Instruction Formats in Dentistry Completed by Early Career Veterinarians

Educators and employers differed in their perceptions of clinical dental instruction formats completed by early career veterinarians. While a majority in both groups acknowledged didactic instruction, educators reported higher rates of wet lab (75.0% vs. 46.2%) and live patient training (96.4% vs. 38.5%) compared to employers. In contrast, employers more frequently identified simulation training (30.8% vs. 14.3%) than educators.

Figure 4.1 presents the percentage of educators and employers selecting each instructional format, allowing for visual comparison across groups. Table 4.5 reports the results of Fisher's Exact Test for each instructional method, highlighting which group differences reached statistical significance.

Table 4.5: Perceived Formats of Clinical Dental Instruction in DVM Programs

Format	% of Educators Selected	% of Employers Selected	P-value
Didactic	57.1	61.5	1.0000
Simulation	14.3	30.8	0.2372
Wet Lab	75.0	46.2	0.0885
Live Patient	96.4	38.5	0.0001 ***
None of These	0.0	23.1	0.0268 *

Didactic instruction was selected by 57.1% of educators and 61.5% of employers, with no statistically significant difference between groups (p = 1.00). There were also no significant differences for simulation training (p = 0.237) or wet lab training (p = 0.0885).

However, live patient instruction was selected by 96.4% of educators but only 38.5% of employers—a statistically significant difference (p = 0.0001), suggesting that educators and employers may have divergent views on the extent of hands-on clinical experience students receive.

“None of these” was also statistically significant at the 5% level. While no educators selected this option, 23.1% of employers indicated that they believed none of the listed instructional formats were used during the clinical year (p < 0.05).

4.6 S6

Research Question: Do educators and employers differ in their views on which formats of clinical instruction in dentistry should be required for DVM students as part of their clinical training?

In Question 21 of the employer survey, participants were asked:

• “Which of the following types of clinical instruction in dentistry do you think DVM students should be required to complete as part of a DVM program? Select one response for each of the instructional types listed below.”

The analogous question for educators appeared as Question 17 and stated:

• “Which of the following types of instruction do you think DVM students should be required to complete as part of their clinical training? Select one response for each type of instruction listed below.”

This question aimed to assess perceptions regarding which types of dental instruction should be required in the veterinary medical curriculum across both survey groups. Table 4.6 presents the Mann–Whitney U test results, summary statistics, effect sizes, and ranked-biserial correlation outputs.

Table 4.6: Mann-Whitney U-Test Results for Clinical Instruction Formats

	Median		N		Effect Size	
Skill	Med (Edu)	Med (Emp)	N (Edu / Emp)	P-Value	r_rb	Interpretation
Live Patient	4	4	28 / 13	0.004 **	-0.35	Medium negative effect
Simulation	3	4	20 / 12	0.366	0.18	Small positive effect
Didactic	4	4	23 / 13	0.467	0.13	Small positive effect
Wet Lab	4	4	24 / 13	0.658	0.05	Negligible effect

The Mann–Whitney U test revealed a statistically significant difference ($p = 0.004$) between employers and educators when evaluating the importance of Live Patients. Although both groups reported a median rating of 4, suggesting similar central tendencies, the ranked-biserial correlation ($r_{rb} = -0.35$) indicates a medium negative effect. This suggests that employers generally rated

Live Patient instruction as more essential than educators did. The difference in ranking distributions is statistically meaningful.

No statistically significant differences were found between the groups regarding the instructional types Simulation ($p = 0.366$), Didactic ($p = 0.467$), or Wet Lab ($p = 0.658$). The ranked-biserial correlations for Simulation ($r_{rb} = 0.18$) and Didactic ($r_{rb} = 0.13$) were small and positive, indicating a slight tendency for educators to rate these types of instruction as more important than employers. The effect size for Wet Lab ($r_{rb} = 0.05$) was negligible. None of these differences reached statistical significance. The instructional categories "None of These" and "Other" were excluded from Table 4.6 due to insufficient data for statistical testing.

Figure 4.2 presents the proportional distribution of responses for each group. While a moderate difference was observed between groups regarding the use of live patients, the majority of participants in both groups selected Strongly Agree, and notably, no participants selected Disagree or Strongly Disagree — indicating strong consensus that live patient experience should be required in clinical training.

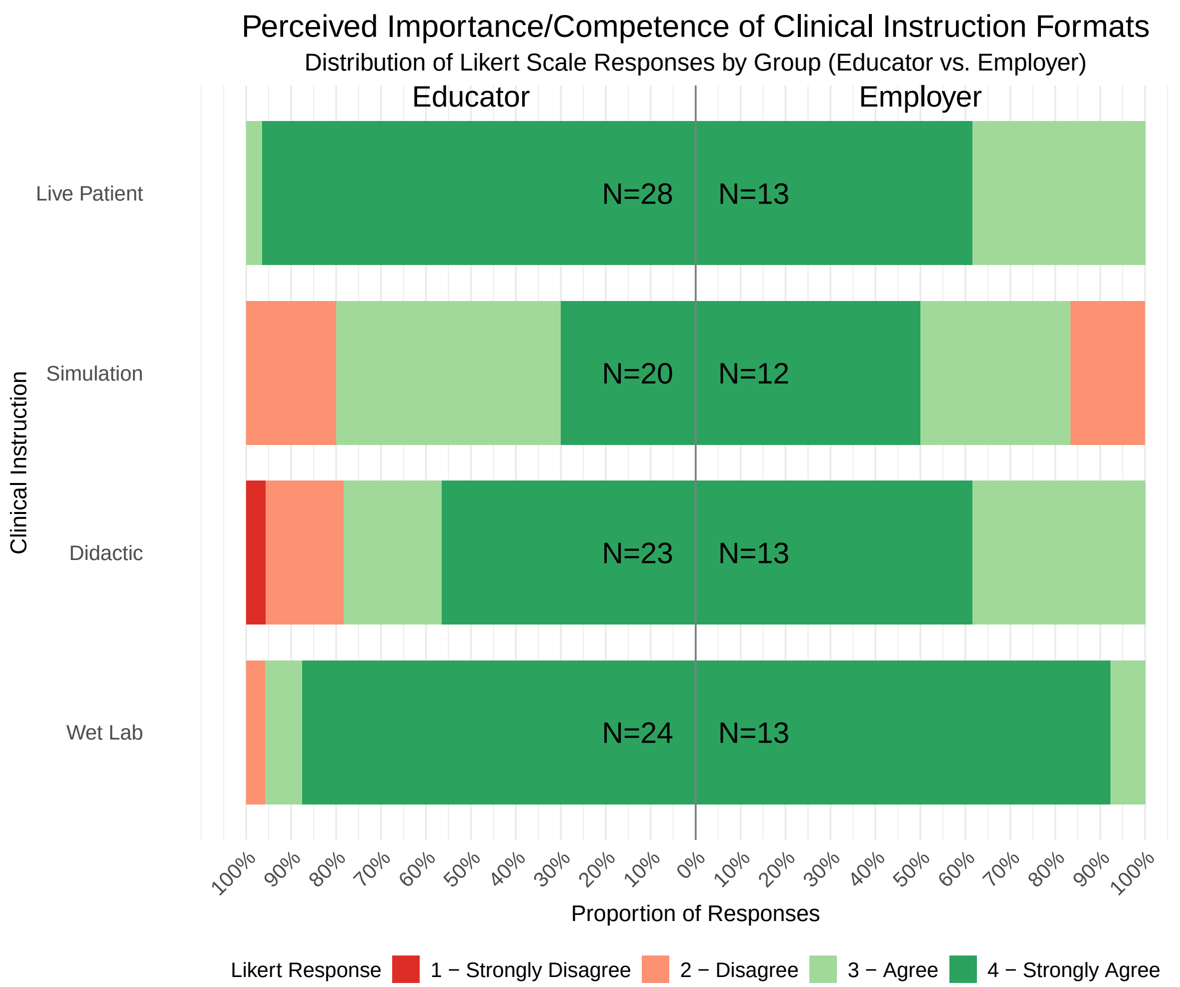

Figure 4.2: Diverging Stacked Bar Chart of Perceived Importance/Competence of Clinical Instruction Formats by Group (Educator vs. Employer).

The response distributions for simulation and wet lab instruction appear nearly identical visually, and statistical analysis confirmed no significant differences between groups for these instructional types. Interestingly, the distribution for didactic instruction looks somewhat different from those two, despite also showing no statistically significant difference.

This highlights an important point: even when one bar chart appears to show more variability in proportions than another, the overall ranking of responses between groups may still be similar. The Mann–Whitney U test is designed to detect consistent directional differences in how groups rank responses. If those patterns are weak, inconsistent, or cancel each other out, the test will indicate no significant difference — even when the visualizations suggest otherwise. Differences in sample size and variability can also exaggerate or smooth over apparent contrasts that don't reflect meaningful differences in central tendency.

4.7 S7

Research Question: Is there a difference between the clinical dentistry skills that educators report DVM students are learning during their clinical training and the skills that employers believe recent graduates have completed as part of their DVM program?

Both educators and employers were asked a question related to skills learned and practiced during the clinical year.

On question 25 of their survey, employers were asked: "Which of the following skills do you think that individuals who graduated with a DVM degree after May 2021 completed during the clinical training portion of their DVM program? Select all that apply."

On question 20 of their survey, educators were asked: "Which of the following skills are DVM students at your institution practicing/learning during the clinical training portion of the DVM program? Select all that apply."

Since the question was of the format "select all that apply," participants were able to select more than one response, and percentages will not add to 100%. Results reported below are the percentages of their respective group (educators or employers) that selected the given format of instruction. Percentages were utilized due to the difference in sample size.

Educators and employers were also given the option to enter their own responses to the question. No employers entered any text responses. Six educators entered text responses, as follows:

- "OvaVet gel application, Crown amputation, Sealant application for UCF, oral tumor biopsy and excision, orthodontia"
- "Nerve blocks, barrier sealant and bonded sealant application, jaw fracture repair, root canals"
- "Often—bonded sealants; Sometimes—root canals, restorations, jaw fracture repair"
- "Oral biopsy, root planning, bonded sealants"
- "Extractions only if performed on that patient"

- "Not all students see all types of extractions"

Figure 4.3 shows the percentage of employers and educators who selected the given skills.

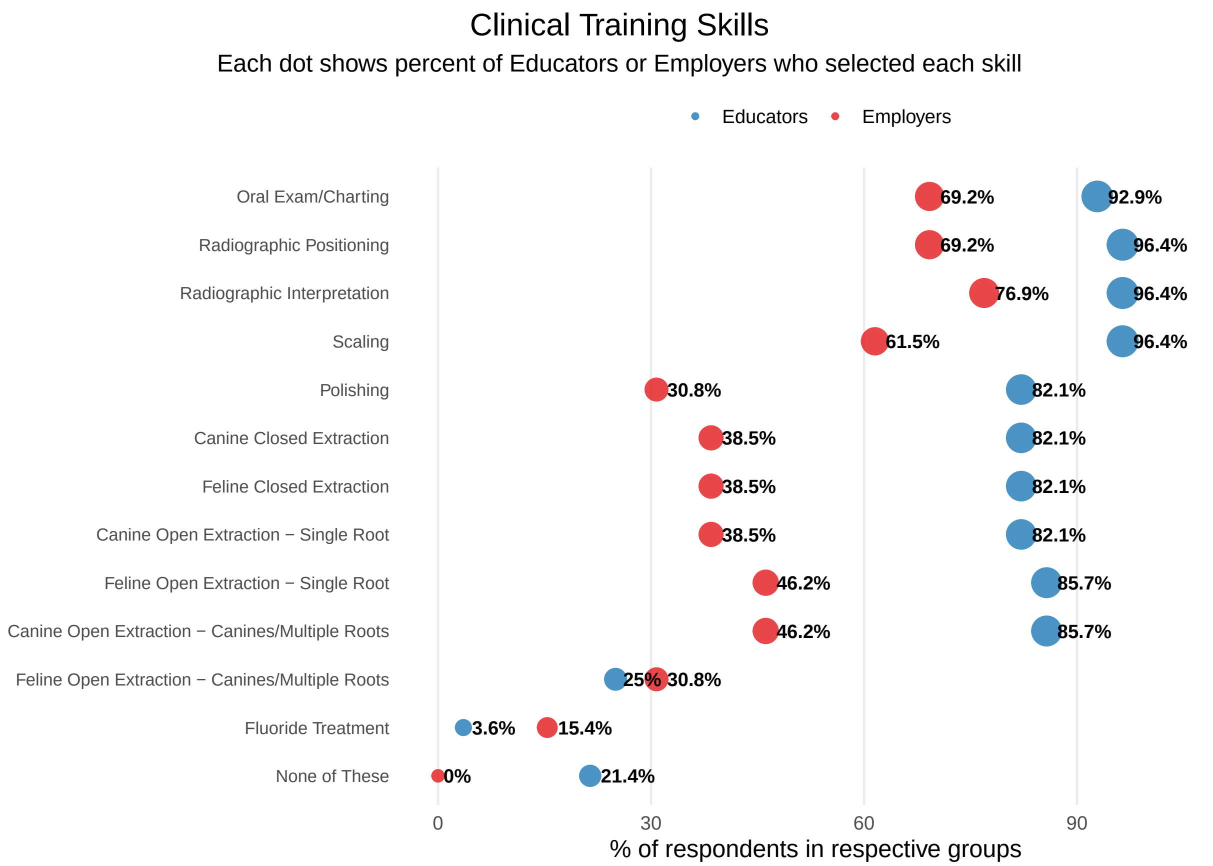

Figure 4.3: Clinical Training Skills Perceived by Educators vs Employers in DVM Programs

Table 4.7 shows the p-values associated with Fisher's Exact Test and their significance. For eleven of the thirteen skills, educators reported a higher percentage of selection. The two skills for which employers reported higher perceived learning were feline open extraction—canines/multiple roots—and fluoride treatment.

Table 4.7: Perceived Skills Learned of Clinical Dental Instruction in DVM Programs

Skill	% of Educators	% of Employers	P-value
Oral Exam/Charting	92.9	69.2	0.0685
Radiographic Positioning	96.4	69.2	0.0284 *
Radiographic Interpretation	96.4	76.9	0.0861
Scaling	96.4	61.5	0.0084 **
Polishing	82.1	30.8	0.00331 **
Canine Closed Extraction	82.1	38.5	0.0102 *
Feline Closed Extraction	82.1	38.5	0.0102 *
Canine Open Extraction - Single Root	82.1	38.5	0.0102 *
Feline Open Extraction - Single Root	85.7	46.2	0.0193 *
Canine Open Extraction - Canines/Multiple Roots	85.7	46.2	0.0193 *
Feline Open Extraction - Canines/Multiple Roots	25.0	30.8	0.719
Fluoride Treatment	3.6	15.4	0.232
None of These	21.4	0.0	0.152

At the 5% significance level, the difference in skill selection between employers and educators was found to be significant for seven skills:

- Radiographic Positioning (p = 0.0284)
- Scaling (p = 0.0084)
- Polishing (p = 0.00331)
- Canine Closed Extraction (p = 0.0102)
- Feline Closed Extraction (p = 0.0102)
- Canine Open Extraction—Single Root (p = 0.0102)
- Feline Open Extraction—Single Root (p = 0.0193)
- Canine Open Extraction—Canines/Multiple Roots (p = 0.0193)

For all skills with statistically significant differences, educators reported higher percentages than employers.

The largest difference was found in polishing. Educators selected this skill 82.1% of the time, while employers selected this skill only 30.8% of the time. The resulting p-value was 0.00331.

4.8 S8

Research Question: Do educators and employers differ in their opinions about which clinical dentistry skills DVM students should be required to practice or learn during their clinical training?

In question #26 of the employers' version of the survey, participants were asked:

“Which of the following skills do you think that DVM students should be required to practice/learn as part of the clinical training portion of a DVM program? Select one response for each of the skills listed below.”

The corresponding question for educators was survey question #21.

This question aimed to assess opinions on which clinical dentistry skills should be required in DVM student training. Table 4.8 presents the Mann–Whitney U-test results, summary statistics, effect sizes, and ranked-biserial correlation outputs.

Table 4.8: Mann-Whitney U-Test Results for Clinical Procedures

Skill	Median Med (Edu)	Med (Emp)	N N (Edu / Emp)	P-Value	Effect Size r_rb	Interpretation
Feline closed extraction	4	4	26 / 11	0.064 .	0.27	Small positive effect
Canine open extraction - Single root	4	4	26 / 11	0.064 .	0.27	Small positive effect
Feline open extraction - Single root	4	4	26 / 11	0.092 .	0.23	Small positive effect
Canine open extraction - Canines/multiple roots	4	4	26 / 11	0.092 .	0.23	Small positive effect
Radiographic interpretation	4	4	26 / 11	0.261	0.12	Small positive effect
Feline open extraction - Canines/multiple roots	3	4	16 / 9	0.276	0.26	Small positive effect
Canine closed extraction	4	4	26 / 11	0.437	0.11	Small positive effect
Radiographic positioning	4	4	26 / 11	0.510	-0.10	Negligible effect
Scaling	4	4	26 / 11	0.578	-0.09	Negligible effect
Polishing	4	4	26 / 11	0.816	-0.03	Negligible effect
Oral exam/charting	4	4	26 / 11	0.829	0.03	Negligible effect

Nearly every skill reported a median of 4, with the exception of Feline Open Extraction – Canines/Multiple Roots, whose central tendency was 3. Note that this exception is also the only row that reports fewer responses than the others. Small but consistent differences were found for several clinical procedures, with educators tending to rate certain skills as more important than employers.

Specifically, educators rated the following procedures as more important (higher median values) compared to employers:

- Feline closed extraction (effect size: $r = 0.27$)
- Canine open extraction – single root ($r = 0.27$)
- Feline open extraction – single root ($r = 0.23$)

- Canine open extraction – canines/multiple roots ($r = 0.23$)
- Feline open extraction – canines/multiple roots ($r = 0.26$)
- Radiographic interpretation ($r = 0.12$)
- Canine closed extraction ($r = 0.11$)

All of these showed small positive effect sizes, indicating that educators placed slightly more emphasis on these procedures than employers. However, none of these differences reached conventional levels of statistical significance (i.e., $p < 0.05$), though some were marginal ($p \approx 0.06$–0.09). Negligible differences were found for the following skills:

- Radiographic positioning ($r = -0.10$)
- Scaling ($r = -0.09$)
- Polishing ($r = -0.03$)
- Oral examination/charting ($r = 0.03$)

These results suggest that educators and employers generally agreed on the importance of these particular skills, with only very small or no measurable differences between groups.

While the effect sizes for several procedures suggest that educators may place slightly more value on certain clinical extraction skills and radiographic interpretation than employers, these differences were not statistically significant. The negligible effect sizes for basic procedures such as polishing and oral exams indicate a strong consensus between the two groups regarding these skills. Figure 4.4 shows that the distribution of responses is broadly similar, and although some differences exist, they do not reach statistical significance to suggest meaningful divergence in perceptions of clinical competencies. Notably, the procedure Feline Open Extraction – Canines/Multiple Roots exhibits the greatest variability; however, this may be influenced by the smaller number of responses for that item.

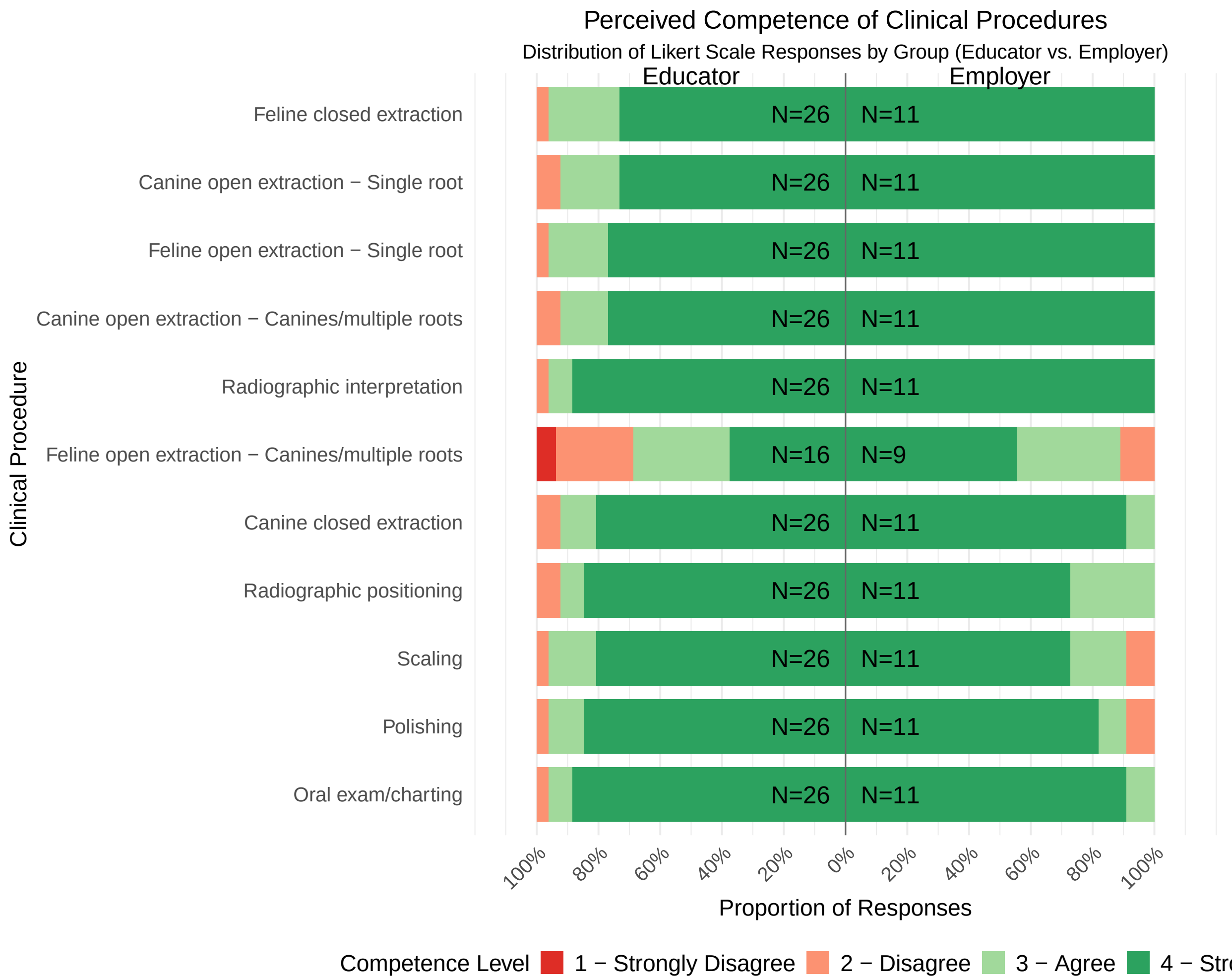

Figure 4.4: Diverging Stacked Bar Chart of Perceived Competence of Clinical Procedures by Group (Educator vs. Employer).

5 Discussion/Conclusion

5.1 Interpretation of Results

Overall, the results suggest that educators and employers are largely aligned in their perceptions of veterinary dental training and graduate competence. Both groups reported similar expectations about which skills are taught preclinically and the types of clinical experiences students receive. However, subtle differences in emphasis emerged.

Employers placed greater importance on advanced skills such as complex extractions and expected more extensive hands-on experience during clinical rotations. Educators, meanwhile, expressed slightly more confidence in graduates' radiograph interpretation abilities. While these differences were not statistically significant, they may reflect underlying mismatches in expectations or communication gaps.

One area of clearer divergence involved support for live patient instruction: employers were more likely than educators to emphasize its importance, whereas both groups viewed wet labs and simulations similarly. Additionally, educators consistently rated graduates as more competent across multiple skills, suggesting they may have greater confidence in current training approaches compared to employers. The fact that some employers believed certain instructional methods were not being used at all raises concerns about transparency or awareness of educational practices.

5.2 Implications

These findings highlight opportunities to improve alignment between veterinary education and employer expectations:

Transparency and Communication: Employers often underestimated the extent of dental training provided. Improving communication—through externship feedback, employer advisory boards, or graduate transition reports—could strengthen mutual understanding and trust.

Curriculum Evaluation: Employers placed more emphasis on certain advanced procedures. Veterinary programs may benefit from reviewing whether current curricula adequately reflect real-world demands, particularly regarding procedures like open extractions and fluoride treatment.

Clinical Exposure: Employers expected a greater number of completed procedures during clinical training. This points to a need to ensure students have sufficient opportunities for procedural repetition and experience, particularly in dentistry-specific rotations.

Competency Standards: Establishing shared definitions of competence could help align assessment criteria between educators and employers, particularly for more complex skills.

5.3 Limitations

This study has several limitations. The small sample size—especially among employers—limits the generalizability of findings and reduces statistical power. Self-selection bias may have been introduced by recruiting participants through professional and personal networks.

Geographic and demographic imbalances were also present. Most employers were practice owners located on the U.S. East Coast, while educators were more geographically diverse. Additionally, all data were self-reported, which introduces potential variation in how participants interpreted survey items. Missing responses in some areas also reduced the robustness of certain comparisons.

5.4 Recommendations

To strengthen alignment between academic preparation and clinical practice:

Facilitate Dialogue: Engage stakeholders—through surveys, advisory boards, and curriculum reviews—to ensure that curricula remain relevant and responsive to clinical demands.

Clarify Expectations: Clearly communicate curricular goals and clinical training standards to both students and employers.

Enhance Hands-on Training: Evaluate clinical caseloads and procedural opportunities, particularly in high-priority areas like radiograph interpretation and extractions.

Standardize Competency Criteria: Adopt shared definitions of graduate readiness for core dental skills.

5.5 Summary of Key Findings

Educators and employers were broadly aligned in their perceptions of dental training, but key perception gaps remain. Employers tended to underestimate preclinical instruction and expected more procedural experience during clinical rotations. They also placed greater emphasis on certain skills, such as feline open extractions and fluoride treatment. While most statistical differences were non-significant, these trends suggest opportunities to strengthen communication and curricular alignment.

5.6 Final Thoughts

This study highlights strong overall agreement between educators and employers on core dental competencies while identifying important areas for improvement. Narrowing perception gaps—particularly around training volume, advanced skill instruction, and graduate readiness—can foster smoother transitions into practice, reduce onboarding burdens, and ultimately enhance the quality of veterinary dental care. Continued collaboration between veterinary programs and the profession will be essential to ensuring that graduates are both well-trained and well-understood.

Appendix

American Veterinary Medical Association. (2019). *Census of veterinarians finds trends, shortages, practice ownership*. https://www.avma.org/javma-news/2019-07-15/census-veterinarians-finds-trends-shortages-practice-ownership