Learning Characteristics of Veterinary Technology Students in a Distance-Education and an On-Campus Program

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ABSTRACT

Distance-education programs have the potential to greatly increase the number of veterinary technicians. The demographic characteristics, readiness for independent and online learning, learning styles, and academic locus of control of a group of distance-education and on-campus veterinary technology students were examined. Distance-education students preferred independent learning and were more internally motivated to learn. Distance-education students with greater degrees of independence and internal motivation participated more fully, were more satisfied with their learning, and achieved higher grades. Students who preferred problem solving and active experimentation were particularly successful in distance education. These findings could have important implications for advising students interested in distance-education programs.

Key words: distance education, e-learning, student characteristics

INTRODUCTION

Accredited distance-education degree programs in veterinary technology were developed in the late 1990s to address the unmet need for veterinary technicians in North America.[1–5] Distance-education programs offer economies of scale, providing access to large numbers of students living and working outside the range of traditional on-campus programs.[4] Generally, distance-education students complete the academic portion of their program through independent reading and Web-based or video lectures and demonstrations and the practical components through preceptor-supervised work experience. Because distance-education programs do not deliver on-campus practical and clinical experiences, class size is not subject to the same limits as traditional on-campus programs. Distance education differs from on-campus education with respect to the degree of student independence and control in the learning environment.[6,7] Distance-education students are more often female, older, married, and employed full-time, and are more likely to be enrolled in distance education for personally defined reasons.[3,4,8–10]

Distance-education and traditional programs provide similar academic content and are designed to prepare students for a standardized national examination. Both programs require general education courses; on-campus students generally complete their courses in biology, mathematics, composition, and communication prior to enrollment, while distance-education students complete their courses concurrently with veterinary technician courses. Most students in distance-education programs take courses on a part-time basis, and many take five years or more to graduate. In contrast, the on-campus program is designed to be completed on a full-time basis in two years, provided that the general education courses are completed prior to admission to the program. Students in the distance-education program complete didactic material independently online and learn practical skills through work experience, with practicing veterinarians and/or credentialed veterinary technicians serving as preceptors. Students in the on-campus program receive didactic material in classroom lectures and learn practical skills in laboratory and clinical courses.

Attrition rates are higher in distance-education programs than in on-campus programs: approximately 50% of students continue beyond the first course.[10–14] Factors associated with the higher drop-out rate include older age, being married, and having family commitments.[10] Other factors include technological barriers, learning styles, motivation to learn independently, and institutional and circumstantial factors, such as distance from an accredited educational program.[10,15,16] It is essential to understand the characteristics of successful distance-education learners in order to appropriately counsel students considering enrolling in distance-education programs and to build program supports to ensure success.

The number of distance-education veterinary technology programs is increasing, but there is little information available comparing learner characteristics of students in distance-education and on-campus programs. The ability to use a computer should be a key to success in distance education, but most on-campus college courses require some ability to use computers for accessing course and library-based information. In one study, veterinary technology students taking a distance-education veterinary physiology course as part of their program rated themselves ''pretty good'' to ''extremely good'' at using computers.[18] It was anticipated that both groups would be able to use computers but that distance-education students might have a greater preference for independent learning and for receiving information in an online format. Known indices of readiness for online learning include the availability of computers and level of computer skill, the degree

of independent learning aptitude, and time-management ability.[7,15,16,18]

Research on learning styles has shown that students approach and respond to learning experiences in many ways.[7,19,20] Although learning-style inventories are somewhat controversial, educators use them to match students with appropriate instructional materials and counseling regarding distance education.[20–23] Students' response to the learning environment is an important predictor of retention in distance education programs; thus, we predicted that students with different learning styles would have varying levels of academic success and satisfaction with the two different components of the programs (didactic information and clinical preceptorship).[24]

Student control of learning is a critical component of distance education.[7] Students with an *internal locus of control* take greater control over their own learning and attribute their learning and performance to internal factors, such as effort. Students with an *external locus of control* attribute learning and performance to factors outside of their control, such as the instructor's teaching or luck.[25] Successful distance education students should exhibit a more internal locus of control, particularly given the amount of independent, student-centered learning required.

The goals of this study were to compare learner characteristics of distance-education and on-campus students enrolled in veterinary technology programs and to investigate characteristics of successful distance-education veterinary technology students.

METHODS

A total of 614 distance-education students and 53 on-campus students enrolled in a veterinary technology program leading to an associate's degree in applied sciences were sent an e-mail requesting their participation in an online survey during the second-to-last week of the term. A reminder was sent 10 days later. The solicitation e-mail introduced the study and provided a link to the appropriate survey. Participants indicated their willingness to participate by completing the survey. The survey included demographic and program-related questions and three personality scales. Human subjects approval was obtained from the university's institutional review board, as well as the permission of the president of the college, prior to the study.

The survey contained demographic questions, program-related questions, an index of readiness for online learning,[17] a learning styles index,[23] and a locus of control index.[26] Basic demographic questions addressed age, gender, racial identity, and previous education, as well as gathering data on general computer skill and access, self-reported grade-point average, and satisfaction with learning. The wording of several of the demographic questions differed between the two groups to account for the flexibility of the distance-education program.

Readiness for online learning was assessed using the Readiness Index for Online Learning,[17] a 20-item questionnaire that considers student independence and self-directedness. Examples of questions are the following: "The type of learning environment I learn best in is . . ."; "When confronted with technology that is new to me, I . . ." Each item had three potential responses: one consistent with a preference for or suitability for on campus classes; one consistent with a preference for or suitability for online classes; and one between the two extremes. A score of 1 was assigned for responses indicating a preference for an on-campus course, a 3 for responses indicating a preference for an online course, and a 2 for in-between responses. The score for this measure was created by totaling the scores for the different items. The potential range of scores for this measure was 20–60; higher scores reflect a preference or suitability for an online program.

Learning styles were assessed using the Kolb Learning Styles Inventory.[23] Various measures are constructed from students' responses to 12 statements (e.g., "I learn by . . ."), each with four response options reflecting a learning preference for experiencing, reflecting, thinking, and doing. The options were rank-ordered in terms of personal preference, with 4 indicating a statement "most like" the respondent and 1 indicating a statement "least like" the respondent. Ranks were summed for different options to create scores on subscales of Concrete Experience (CE, experiencing), Reflective Observation (RO, reflecting), Abstract Conceptualization (AC, thinking), and Active Experimentation (AE, doing). Two additional scores were created by subtracting the CE score from the AC score to create a measure of preference for abstractness as opposed to concreteness (AC-CE) and by subtracting the RO score from the AE score to create a measure of preference for action over reflection (AE-RO). Values on the AC-CE and AE-RO were used to determine preferred learning style, based on norming studies[23]. The relationship between the subscales on the Learning Style Inventory and the resulting learning styles is shown in Figure 1. A value less than or equal to 7 on the AC-CE and less than or equal to 6 on the AE-RO defines a Diverging learning style, indicating a preference for experiencing and reflecting; this is shown in the upper right quadrant of the figure. A value greater than

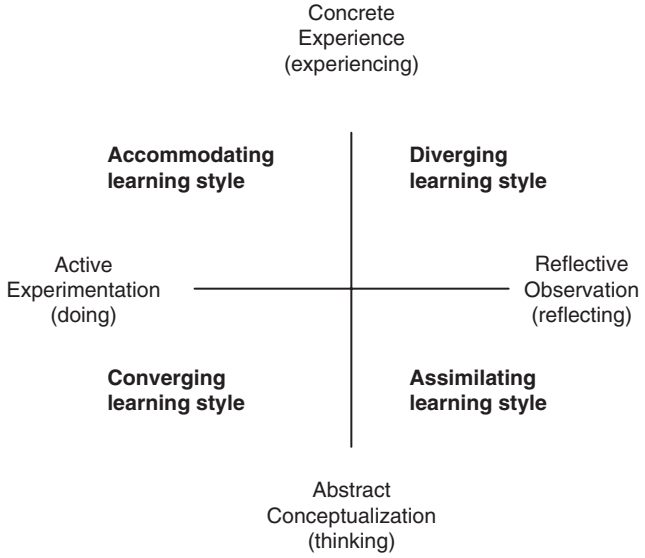

Figure 1: Diagram of Kolb Learning Styles derived from the subscales of the Learning Style Inventory (adapted from Kolb and Kolb[23])

or equal to 8 on the AC-CE and greater than or equal to 7 on the AE-RO defines a Converging learning style, indicating preferences for thinking and doing; this is shown in the lower left quadrant of Figure 1, diagonal to the Diverging learning style. A value less than or equal to 7 on the AC-CE and greater than or equal to 7 on the AE-RO defines an Accommodating learning style, indicating preferences for experiencing and doing (upper left quadrant). A value greater than or equal to 8 on the AC-CE and less than or equal to 6 on the AE-RO defines an Assimilating learning style, indicating a preference for thinking and reflecting (diagonal to the Accommodating learning style).

Students' perceptions of control over their academic performance and outcomes were assessed using the Trice Academic Locus of Control.[26] This measure consists of student true/false responses to 28 statements such as ''College grades most often reflect the effort you put into classes.'' Higher scores on the scale represent a relatively greater external locus of control, with scores of 0–13 representing an internal locus of control and scores above 13 representing an external locus of control.

Cronbach's alpha was used to evaluate reliability of the various measures. Chi-square likelihood ratios were used to investigate differences based on the demographic variables. Welsh *t*-tests were used to compare scores on the learning characteristics between on campus and online students because of the large difference in sample sizes. Analysis of variance (ANOVA) for repeated measures was used to analyze differences between the two groups of students in terms of learning style and the learning scores from the learning style inventory, with type of program (distance education versus on-campus) and learning style (Diverging, Converging, Accommodating, Assimilating) as between-subjects variables and the four learning scores (Abstract Conceptualization, Concrete Experience, Active Experimentation, Reflective Observation) as repeated measures. The effect of learning style on readiness for online learning was assessed using a one-way ANOVA. Tukey post-hoc analyses were used to identify differences. Spearman rank-order correlations were used to examine relationships between the outcome measures of learning and program satisfaction with background variables, program participation, and other satisfaction variables. Finally, stepwise regression was used to predict program satisfaction. All analyses were evaluated at the 0.05 probability level.

RESULTS

The response rates for distance-education students and on-campus students were 39.9% (245/614) and 35.8% (19/55), respectively. Less than 1% of e-mails were returned due to incorrect addresses. Reliability scores for the responses ranged from moderate to very high. Reliability for online readiness was very high ($\alpha = 0.94$); the learning style subscales were of moderate to high reliability ($\alpha = 0.72$–0.84).[23] Reliability for locus of control was very high ($\alpha = 0.96$).

Demographic information for the respondents is shown in Table 1. Respondents were representative of the population in each program in terms of gender, age, and the number enrolled in each level or year. The distance-education program is divided into four levels, with most students enrolled in introductory courses. The distribution of respondents closely reflected the enrollment distribution in the distance-education program, with 57.6%, 27.8%, 9.4%, and 5.3% of the respondents in levels 1, 2, 3, and 4, respectively. The majority of respondents from the on-campus program were in their first year (68.4%), reflecting the smaller number of students in the second year of the on-campus program because of attrition and advancement rates. Most distance-education students (90%) lived in another state; 4% lived in-state, 3% lived within driving distance of the college, and 3% lived outside the United States.

The rest of the results are divided into two sections: comparisons between distance-education and on-campus students, and an examination of learning characteristics of distance-education students as they relate to students' perceptions of satisfaction and learning.

COMPARISONS BETWEEN DISTANCE-EDUCATION AND ON-CAMPUS STUDENTS

Table 1 shows the demographic statistics for both distance-education and on-campus students. Significantly more ($p < 0.001$) distance-education students than on-campus students had previous veterinary experience, and significantly more ($p < 0.001$) distance-education students were employed full-time. As shown in Table 1, there were no significant differences in age between the on-campus

Table 1: Demographic information for distance-education and on-campus students

Demographic Variable	Type of Program	
	Distance Education ($N = 245$)	On Campus ($N = 19$)
Age (mean years)	32.4	31.0
Female (%)	94.3	94.7
Is married or living common-law (%)	53.5	68.4
Has children (%)	27.3	26.3
Identifies as Caucasian (%)	91.4	89.5
Speaks English as a first language (%)	98.4	100.0
Has more than high school education (%)	85.3	89.5
Has previous veterinary experience (%)	95.5	63.2*
Is employed full-time (%)	88.6	26.3*
Self-rates computer skill as ''good'' to ''excellent'' (%)	88.6	94.8
Self-rates Internet skill as ''good'' to ''excellent'' (%)	91.4	89.5
Has previous experience with online instruction (%)	21.6	31.6

*$p < 0.01$

Table 2: Means and standard deviations for the readiness index for online learning, learning style inventory, and academic locus of control scales

Scale	Type of Program	
	Distance Education Mean (*SD*)	On Campus Mean (*SD*)
Readiness Index for Online Learning	50.1 (4.6)	45.3 (4.0)*
Learning Styles Inventory		
Concrete Experience (CE)	27.9 (7.5)	30.0 (8.0)
Reflective Observation (RO)	31.0 (6.8)	31.1 (7.5)
Abstract Conceptualization (AC)	29.7 (7.3)	26.2 (7.8)
Active Experimentation (AE)	35.9 (6.6)	35.8 (5.1)
AC - CE	1.9 (9.7)	−3.8 (13.0)
AE - RO	4.9 (9.0)	4.8 (8.0)
Academic Locus of Control	9.7 (3.8)	12.4 (3.4)*

*$p < 0.01$

and distance-education students, consistent with general demographic information on students from the two programs.

Scores for online readiness, learning style inventory, and locus of control are reported in Table 2. Online readiness scores were significantly higher ($p < 0.005$) for distance-education students than for on-campus students, but responses indicated that on-campus students also demonstrated readiness. Responses relating to independence revealed the largest differences. For example, for the item ''Face-to-face interaction with the instructor is . . .'' the most common response for distance-education students was ''Not necessary for my success,'' whereas the most common response for on-campus students was ''An important part of the learning process for me.'' Similarly, in response to the statement, ''The type of learning environment I learn best in is . . .'' distance-education students most frequently chose ''A student-centered environment: I'm on my own, but I have help as needed,'' while on-campus students most commonly chose ''A teacher-directed environment with all material explained in detail.'' Both groups responded similarly to statements such as ''I consider my reading skills to be . . .'' and ''My access to an Internet-ready computer is . . .''

No differences in learning styles were detected between groups on the four subscales and combined subscales; the patterns of means most closely resembled those of undergraduate students in the arts.[23] No strong differences between the two sets of subscales—Abstract Conceptualization versus Concrete Experience and Active Experimentation versus Reflective Observation—were found, indicating no preferences for one type of learning environment over another. A more meaningful interpretation of the learning style inventory came from categorizing students into the four learning styles: Diverging, Converging, Accommodating, and Assimilating. Table 3 shows the percentage of each type of learning style for distance-education and on-campus students. The distribution of the two groups was not different.

Table 3: Proportions of students in the two programs falling into the four different learning style categories

Learning Style	Type of Program	
	Distance Education %	On Campus %
Diverging	44	44
Converging	13	6
Accommodating	29	33
Assimilating	14	17

We found a significant ($p < 0.001$) main effect of learning score. Consistent with the norming groups, we obtained highest learning scores for Active Experimentation, followed by Abstract Conceptualization, Reflective Observation, and, finally, Concrete Experience. There were also statistically significant interactions ($p < 0.001$) between learning style and learning score, an artifact of the scoring system used to determine learning styles from learning scores. We found no main effects or interactions related to type of program, consistent with the separate analyses of the subscales and combined subscales.

Distance-education students scored significantly lower ($p < 0.005$) on the locus of control scale. Scores between 0 and 13 represent an internal locus of control; means for both groups were below 13, with 78.8% of distance-education students and 47.4% of on-campus students scoring in this range. A significantly higher percentage ($p < 0.01$) of distance-education students were classified as having an internal locus of control.

LEARNING STYLE CHARACTERISTICS OF DISTANCE-EDUCATION STUDENTS RELATED TO LEARNING AND SATISFACTION

The means and standard deviations for online readiness and locus of control are presented in Table 4 as a function of students' preferred learning style. Learning style affected online readiness: students displaying a Converging learning style were more likely to be more independent, as assessed by the online readiness index than those with a Diverging learning style. In addition, there were significant differences between Converging learning style and Diverging and Assimilating learning styles, with an Accommodating learning style falling between them on the locus of control measure. Although all means fell within the internal locus of control region, students with a preference for a Converging learning style had a relatively more internal locus of control.

Proportions of distance-education students by self-reported grades, learning, and satisfaction as a function of learning style are reported in Table 5. Self-reported grade-point averages differed by learning style ($p < 0.05$): more students demonstrating the Converging learning style reported an A

Table 4: Means and standard deviations for distance-education students' scores on the readiness index for online learning and academic locus of control scale as a function of learning style

Measure	Learning Style			
	Diverging Mean (*SD*) (*N* = 102)	Converging Mean (*SD*) (*N* = 30)	Accommodating Mean (*SD*) (*N* = 69)	Assimilating Mean (*SD*) (*N* = 32)
Readiness Index for Online Learning	$49.2\ (4.6)_a$	$52.4\ (4.7)_b$	50.5 (4.0)	50.2 (4.5)
Academic Locus of Control	$10.2\ (3.5)_b$	$8.0\ (2.8)_a$	9.6 (4.0)	$10.4\ (4.5)_b$

a, b Means in the same row that do not share subscripts are statistically significantly different.

Table 5: Distance-education students' responses to the performance, learning, and satisfaction survey items

Item	Learning Style			
	Diverging % (*N* = 102)	Converging % (*N* = 30)	Accommodating % (*N* = 69)	Assimilating % (*N* = 32)
Grade-point average of A	70.6_b	93.3_a	72.5_b	78.1_b
''Very satisfied'' with learning	39.8_b	66.7_a	49.3_b	40.6_b
''Very satisfied'' with program	44.7	63.3	55.1	43.8

a, b Means in the same row that do not share subscripts are statistically significantly different.

average than students with the other learning styles. Similarly, more Converging respondents (66.7%) reported being ''very satisfied'' with their learning compared with approximately 40%, 49%, and 41% of students with Diverging, Accommodating, and Assimilating learning styles, respectively. Similar trends were found for overall satisfaction, but in this case the differences were not statistically significant as a function of learning style.

Correlations between the outcome measures of learning and program satisfaction and background variables, program participation, and other satisfaction variables are presented in Table 6. (Negative values are related to reverse scoring of one of the variables.) The first column of Table 6 shows the correlations with grade-point average (GPA). These correlations are smaller than those shown in the second column for program satisfaction, likely because of a restricted range in GPA (75% of respondents reported an A average). Students who reported better Internet skill, a more positive impression of the usefulness of the Internet for learning, greater readiness for online learning, a more internal locus of control, and greater satisfaction with their learning reported higher grades. Students who reported more frequent use of the Internet, a markedly positive impression of and preference for using the Internet for learning, greater readiness for online learning, a more internal locus of control, greater participation in all online components, and greater satisfaction with all aspects of the program also reported higher overall satisfaction with the program. Removing the Converging students who were more ready for online learning, had a more internal locus of control, and reported greater satisfaction and learning than students classified into the other three types of learning styles did not change the correlations.

Predictors of program satisfaction were determined. Four background variables (perceived helpfulness of the Internet for learning, preference for Internet-based instruction, online learning readiness, and locus of control) and one program-related variable (access to the Internet for the learning materials) predicted program satisfaction ($p < 0.001$). Learning style did not significantly predict program satisfaction; students who held a more positive impression of and preference for the Internet for learning, were more ready for online learning, displayed a more internal locus of control, and made greater use of online course materials expressed a greater satisfaction with their distance-education program.

DISCUSSION

The goals of this study were to compare learning characteristics of distance-education and on-campus students enrolled in veterinary technology programs and to explore relationships among learning characteristics of the distance-education students. Distance-education and on-campus students were similar in terms of age, gender, prior educational experience, and patterns of learning styles, but distance education students were more ready for independent online learning and demonstrated a more internal locus of control. These findings are consistent with the literature on college-level distance-education programs, indicating that results from other programs may be applicable to more specialized veterinary technician students.[6–10, 14, 24, 25]

All students who responded to the survey were successful in terms of grades and learning, but students who displayed a preference for a Converging learning style were more

Table 6: Spearman rank-order correlations between outcome measures (grade-point average, program satisfaction) with background variables, program-related behavior, and satisfaction

Measures	Outcome Measure	
	Average	Program Satisfaction
Background Variables		
Internet skill	−0.13*	–
Frequency of Internet use	–	0.13*
Helpfulness of Internet for learning	0.14*	0.43**
Preference for online instruction	–	0.44**
Readiness Index for Online Learning	−0.25**	−0.38**
Locus of control	0.17*	0.27**
Program-Related Behaviours		
Course access	0.14*	0.35**
Participation in graded discussion	–	0.14*
Participation in student discussion	–	0.16*
Satisfaction		
With instructors	–	0.62**
With preceptors	–	0.38**
With learning	0.17*	0.65**

– not significant
*$p < 0.05$
**$p < 0.001$

ready for online learning, were more internally motivated to succeed, reported higher grade-point averages, and tended to be more satisfied with their own learning. Students who were better prepared for online learning, were more internally motivated, participated more in the online components, and reported greater satisfaction with their learning had higher grades and expressed greater satisfaction with the program.

Several investigators have found that distance-education students are more likely than on-campus students to be older, to be more mature, and to have family and work commitments.[4,8,10,14] We found no differences in terms of age, marital status, or children between the two groups, but distance-education students were more likely to be employed full-time, often in the field of veterinary medicine. Distance-education students indicated a greater preference for independent learning than on-campus students. Given this finding and responses indicating a strong internal locus of control, this study suggests that successful distance-education students take control of their own learning more than on-campus students do.[7,24,2] Age is reported to be an important variable in both the general college distance-education literature and a report on an overview of a veterinary technician distance-education program.[4,6–10] However, other characteristics of the learner, such as learning style and locus of control, seem to be more important to consider in relation to distance-education programs for veterinary technology, both for program development and for student recruitment and retention.

Implications for Program Development

A popular model for designing distance-education opportunities, based on an understanding of the learning styles of students, is the Reading, Reflecting, Displaying, and Doing (R2D2) model.[23,24] This model proposes that students with learning styles that include thinking and doing (e.g., Converging) might be best served by access to quality information (e.g., readings, asynchronous lectures) and discussion as well as to interactive activities. The two major components of successful distance-education veterinary technology programs are didactic learning, both online and through textbook assignments, and active learning through hands-on experience under the guidance of a veterinary professional.[4] A didactic-plus-practical distance-learning program in veterinary technology is appropriately aligned with the learning characteristics we found for successful distance-education veterinary technology students based on the R2D2 model.[24] This finding has important implications both for the development of distance-education veterinary technology programs and for recruiting students who will succeed in these programs.

Implications for Recruitment

Successful distance-education veterinary technology students have varied learning characteristics. This study suggests that the most successful students have a Converging learning style, indicating a preference for thinking about readings and other informational materials that make up the didactic online component of many distance-education veterinary technology programs as well as a preference for active experimentation (e.g., working in the field). Successful students also have an internal locus of control, indicating that they take personal responsibility for their learning and performance, and have strong computer skills and a preference for independent, online learning. Recruitment and selection procedures that identify such students may improve retention and success in distance-education veterinary technology programs.

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