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Critical-Thinking Skills of First-Year Athletic Training Students Enrolled in Professional Programs

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Context: The Examination of Professional Degree Level document presented to the National Athletic Trainers' Association Board of Directors states that research in athletic training education has not investigated differences in the critical-thinking skills of professional athletic training students.

Objective: Investigate the differences in critical thinking and other demographic variables across first-year athletic training students enrolled in professional bachelor's- and master's-degree programs.

Design: Quantitative study.

Setting: District 10 athletic training programs.

Patients or Other Participants: Students (N = 40) enrolled within their first 6 months of a professional athletic training program were asked to complete the California Critical Thinking Skills Test (CCTST). Twelve first-year master's-degree students (8 female, 4 male) and 28 bachelor's-degree students (18 female, 10 male) completed the CCTST (age = 20.73 ± 3.09 years).

Main Outcome Measure(s): Athletic training students in District 10 were asked to complete the CCTST during the first 6 months of their respective programs. Independent *t* tests were used to evaluate the difference in critical-thinking scores between professional master's- and bachelor's-degree athletic training students. A 1-way analysis of variance was conducted to determine differences in critical-thinking skills with regard to gender, age, and parental educational level.

Results: There were no statistically significant differences in critical-thinking skills between bachelor's- and master's-degree athletic training students enrolled in a professional athletic training program ($P = .991$). Additionally, there were no statistically significant differences in critical-thinking skills with regard to gender ($P = .156$), age ($P = .410$), or parental education level ($P = .156$).

Conclusions: The results suggest master's students do not have greater critical-thinking skills than professional bachelor's students before engaging in athletic training education. Therefore, as the professional degree of athletic training transitions to the graduate level, athletic training educators may need to investigate and use pedagogical practices that will graduate critically thinking athletic trainers.

Key Words: Clinical reasoning, athletic training education, undergraduate, graduate, diagnostic reasoning

INTRODUCTION

The Strategic Alliance, comprising the National Athletic Trainers' Association (NATA), the Commission on Accreditation of Athletic Training Education, the NATA Research and Education Foundation, and the Board of Certification, evaluated and concluded the appropriate degree for professional athletic training education should be at the master's-degree level. As a result of the Strategic Alliance recommendation, all professional athletic training programs (ATPs) must be delivered at the master's level by 2022. There are many reasons for this degree change in athletic training education. One of the reasons for this mandate can be found in the Examination of Professional Degree Level document[1] presented to the NATA Board of Directors, which states that professional education at the graduate level will enhance retention of students who are committed to the pursuit of an athletic training career, and will attract students who are better prepared to assimilate the increasingly complex concepts that are foundational for athletic training practice. However, this assumes master's-degree students possess greater critical-thinking (CT) skills than their bachelor's level counterparts.[1] Up to this point, research has not been conducted in athletic training regarding CT skills at matriculation for either level of athletic training students.[1] We responded to the Strategic Alliance's call for CT research and explored whether there was a meaningful difference between CT skills at the bachelor's- and master's-degree levels. This study was our first step as we further explore CT skills in athletic training.

Critical thinking has a variety of definitions.[2–5] Critical thinking is described as the ability to ask pertinent questions, recognize and define problems, identify arguments on all sides of an issue, search and use relevant data, and arrive at carefully reasoned judgments.[2] Critical thinking has also been defined as the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.[3] Many of these definitions are complex, yet the authors of the California Critical Thinking Skills Test (CCTST) have created a simple but accurate definition, which we operationalized for this study: CT is using the process of purposeful, reflective judgment to decide in a thoughtful, truth-seeking, and fair-minded way.[4]

Past studies examining the relationship between athletic training and CT skills investigated student learning objectives,[6] strategies to promote CT,[7,8] and CT predisposition.[5] Furthermore, we found specific studies that investigated CT skills to determine if there are differences between athletic training majors and nonmajors[9] and CT skill differences between undergraduate and entry-level master's athletic training students upon program completion.[10] Wendinger[10] found no differences in CT skills within 1 year of graduation between professional undergraduate and master's-degree athletic training students. Our study's intent was to bridge the gap in athletic training research by investigating if differences exist upon entry into a professional program. Therefore, the purpose of our research study was to investigate if a difference existed in CT skills between master's- and bachelor's-degree athletic training students within 6 months of initial enrollment in a professional ATP. We also investigated if there was a difference in CT scores among students with regard to age, gender, or parental education level.

METHODS

Research Design

An exploratory descriptive survey design was used for this study and was carried out after institutional review board approval.

Participants

Participants were chosen based on their enrollment date into a professional ATP. Enrollment dates varied per program; however, all athletic training students began their respective programs between the months of July and August 2014. All students completed the CCTST by November 2014. Hence, all students completed the assessment within the first 6 months of admission into their respective programs.

We purposely solicited District 10 ATPs for this study. At the time of the study, District 10 had 12 ATPs with either candidacy or accredited status. Out of the 12 programs, we chose a convenience sample of 5 master's-level and 5 undergraduate professional programs. An e-mail was sent to ATP directors (ATPDs) informing them of the study and asking for their permission and assistance to recruit athletic training students. Once we received confirmation that the ATPs were willing to participate, e-mails were sent to the ATPDs who assisted with the recruitment. The ATPDs were asked to forward that e-mail to their first-year students, inviting the students to participate in this study. The e-mail contained information about the research study, including institutional review board information, risks and consent, specific technical requirements for the CCTST, approximate time frame to take the test, a link to the CCTST, and instructions on how to take the CCTST. Athletic training students were also made aware that data collected during this study would be kept anonymous. Participants were informed that the study was voluntary and involved minimal risk, that they could withdraw from the study at any time without penalty, and that they could decline to answer specific questions. By proceeding and completing the survey, consent was implied.

Instruments/Data Collection

We used the 100-point CCTST scale that is most frequently used in the allied health education literature to evaluate CT skills[5,7,11–17] and most accurately reflects CT ability in allied health professionals.[18] The CCTST, developed by Facione[19]

Table 1. Normality of Sample on California Critical Thinking Skills Test Scales

	Class	Shapiro-Wilk		
		Statistic	*df*	Significance
Overall	Master's	0.922	12	.305
	Bachelor's	0.942	28	.126
Analysis	Master's	0.932	12	.397
	Bachelor's	0.946	28	.157
Interpretation	Master's	0.917	12	.262
	Bachelor's	0.908	28	.018[a]
Inference	Master's	0.944	12	.557
	Bachelor's	0.943	28	.131
Evaluation	Master's	0.954	12	.701
	Bachelor's	0.930	28	.062
Explanation	Master's	0.919	12	.277
	Bachelor's	0.933	28	.074
Induction	Master's	0.895	12	.139
	Bachelor's	0.945	28	.146
Deduction	Master's	0.825	12	.018[a]
	Bachelor's	0.947	28	.163

[a] <.05 indicates a nonnormal distribution.

after years of Delphi research, measures overall CT skills as well as analysis, interpretation, inference, evaluation, explanation, induction, and deduction skills, culminating with an overall score measured on a 100-point scale. Eight scores are obtained from the CCTST: overall score and 7 subscale scores (Analysis, Interpretation, Inference, Evaluation, Explanation, Induction, and Deduction). A score between 50 and 62 shows CT is not manifested, between 63 and 69 hints at weak CT skills, between 70 and 78 signifies moderate CT skills, between 79 and 85 suggests strong CT skills, and 86 or higher reveals superior CT skills.[4] Because the CCTST uses dichotomous choices, the Kuder-Richardson 20 (KR-20) reliability measurements tool was used. The Kuder-Richardson 20 scores exceed 0.88 for the CCTST overall score and range from 0.52 to 0.77 for the subscales.[4] Internal consistency has been reported at 0.70 to 0.71.[13] For this study, the CCTST was purchased, delivered to the participants, and reported to the researchers in Microsoft Excel through Insight Assessment (San Jose, CA).

Data Analysis

The data were imported into SPSS (version 23; IBM Inc, Chicago, IL) and coded. Thirty-three bachelor's-degree students and 12 master's-degree students completed the survey, but a total of 5 bachelor's-degree students were excluded from the analysis. Two were excluded for taking less than 15 minutes on the test, indicating that they did not take the test seriously and quickly clicked through the answers.[4] Two participants were excluded for having an extreme overall score that was more than 4 SDs from the bachelor's-degree students' mean, causing the data to be highly skewed. Finally, the CCTST report does not include one survey in which less than 60% of the questions were answered and another in which only 71% of the questions were completed.[4] The researchers determined that if a respondent failed to answer at least 80% of the questions, regardless of his or her score, it would not be a true representation of the respondent's CT skills. In the end, 40 participants, n = 12 (8 women, 4 men) master's-degree students and n = 28 (18 women, 10 men) bachelor's-degree students, were included in the data analysis. The overall mean age was 20.73 ± 3.09 years. The mean age of the master's students was 24.67 ± 3.77 years; that of the bachelor's students was 19.3 ± 0.58 years. A Shapiro-Wilk test was used to verify normality for the overall CT score and each of the 7 subscales of the CCTST (Table 1). After normality of the data was determined, descriptive statistics were calculated to determine mean scores as well as SDs. Independent *t* tests were also calculated to answer our research questions. The overall CT score and 5 of the subscales were considered to have normal distributions with $\alpha = .05$ to determine normality. The 2 subscales that did not have a normal distribution ($\alpha < .05$) were Interpretation ($P = .018$) and Deduction ($P = .018$). As a result, parametric tests were used to determine differences on all but the Interpretation and Deduction constructs. Nonparametric tests were used for these 2 constructs.

RESULTS

Table 2 illustrates the descriptive statistics for the overall CT score on the CCTST as well as the 7 subscales or skill areas. The overall mean on the CCTST for master's students was 72.33 ± 8.250, and the bachelor's students' overall mean was 72.36 ± 5.431. The groups had a combined mean of 72.35 ± 6.294.

To determine if there was a difference between professional athletic training students at the bachelor's or master's level, an independent *t* test was used. No significant differences were found between bachelor's- and master's-degree students for the following subscales: Overall, Analysis, Inference, Evaluation, Explanation, and Induction (Table 3). Additionally, an independent-samples Mann-Whitney *U* test showed that there

Table 2. Descriptive Statistics

	All	Master's	Bachelor's
	Mean ± SD (N = 40)	Mean ± SD (N = 12)	Mean ± SD (N = 28)
Overall	72.35 ± 6.294	72.33 ± 8.250	72.36 ± 5.431
Analysis	73.63 ± 7.337	74.17 ± 8.747	73.39 ± 6.811
Interpretation	79.13 ± 7.907	80.75 ± 8.390	78.43 ± 7.743
Inference	75.70 ± 6.741	75.83 ± 8.397	75.64 ± 6.075
Evaluation	70.25 ± 7.344	69.58 ± 9.278	70.54 ± 6.523
Explanation	71.03 ± 8.845	67.75 ± 8.248	72.43 ± 8.859
Induction	76.05 ± 6.038	75.50 ± 6.599	76.29 ± 5.893
Deduction	72.65 ± 7.329	73.33 ± 10.840	72.36 ± 5.424

Table 3. Independent Samples Test (Master's Versus Bachelor's)[a]

	t	Significance (2-Tailed)	Mean Difference	SE Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Overall	−0.011	.991	−0.024	2.200	−4.478	4.430
Analysis	0.302	.764	0.774	2.561	−4.412	5.959
Inference	0.081	.936	0.190	2.356	−4.579	4.960
Evaluation	−0.372	.712	−0.952	2.562	−6.140	4.235
Explanation	−1.561	.127	−4.679	2.997	−10.746	1.389
Induction	−0.373	.711	−0.786	2.107	−5.051	3.479

[a] $\alpha = .05$; equal variances were assumed for all constructs. $df = 38$.

were no significant differences between the responding master's and bachelor's students for the Interpretation ($P = .457$) and Deduction ($P = .493$) CT constructs.

To determine if there was a difference between men and women, an independent-samples t test was performed. The results indicated there were no significant differences between men and women for the following CT subscales: Analysis, Inference, Evaluation, Explanation, and Induction (Table 4). Additionally, an independent sample Mann-Whitney U test revealed there were no significant differences between male and female athletic training students for the Interpretation ($P = .685$) and Deduction ($P = .664$) CT subscales.

A 1-way analysis of variance was used to determine if there were differences in CT skills regarding age groups (group 1, 19–20 years; group 2, 21–22 years; group 3, 23–24 years; and group 4, over 24 years). There were no significant differences (Table 5) in the following CT subscales with regard to age groups: Analysis ($P = .339$), Inference ($P = .310$), Evaluation ($P = .761$), Explanation ($P = .522$), and Induction ($P = .747$). Additionally, the independent-samples Kruskal-Wallis test showed no significant differences in the CT subscales of Interpretation ($P = .658$) and Deduction ($P = .194$) with regard to age group.

A 1-way analysis of variance was used to determine if there were significant differences in CT skills regarding parental education level (group 1, high school/general equivalency diploma; group 2, associate degree; group 3, bachelor's degree; group 4, graduate/professional degree). There were no significant differences (Table 6) in the following CT subscales with regard to students' parental education levels: Analysis ($P = .415$), Inference ($P = .793$), Evaluation ($P = .793$), Explanation ($P = .994$), and Induction ($P = .332$). Furthermore, an independent-samples Kruskal-Wallis test revealed no significant differences in the CT subscales of Interpretation ($P = .323$) and Deduction ($P = .717$) with regard to parental education levels.

DISCUSSION

Our study aimed to determine if a difference existed between CT scores of bachelor's- and master's-degree athletic training students within 6 months of initial enrollment in a professional ATP. In this study, we discovered the CT scores of bachelor's- and master's-degree athletic training students did not differ significantly. There were no statistically significant differences in CT scores among participants with regard to age, gender, or parental education level. Therefore, our results do not support the currently held belief that master's-degree athletic training students have greater CT skills than bachelor's-degree athletic training students.[1] Our findings are consistent with previous athletic training research.[5–10] Wendinger[10] investigated CT skills during the last year of coursework between athletic training students in professional bachelor's and master's degrees. Results demonstrated no difference between groups in CT skills. Although these results are similar to this study, the samples differ on time of CCTST data collection. Additionally, our study found no differences in relation to gender, age, and parental educational level. These findings were consistent with other studies on gender,[15,20–24] age,[15,20–22,25–27] and parental educational level.[28–30] Therefore, our study further supports CT disposition as a trait that does not depend on general personal characteristics.

Critical thinking requires a reflective component and some level of experience to make decisions. The concept of time and reflection as it relates to an increase in CT is supported in the literature.[20,27,31–34] Likewise, prior research[31–33] has demonstrated that postsecondary education may positively influence CT. Pascarella et al[32] investigated CT of differential exposure to postsecondary education and determined that the number of credit hours taken had a modest effect on end-of-first-year CT regardless of the confounding variables of age, race, gender, work responsibilities, and types of courses taken. Several other studies[20,27,31,34] have also supported improvement in CT scores over time. In contrast, there have been other studies[10,17,35–38] that revealed no significant change in CT over time. In our study, we investigated students' CT within the first 6 months of program matriculation, assuming the bachelor's-degree group had obtained fewer university credits and less education before entering the ATP as compared with master's-level students. Therefore, further research investigating master's-level CT and clinical decision making is needed.

Based on conflicting results regarding the differences in student CT skills before and after bachelor's-level and graduate work, it is important to investigate the role of other variables (pedagogical practices, prerequisite courses, and clinical education) in increasing CT skills in athletic training students. Research has reported that certain thinking dispositions may lend themselves to the development of CT skills.[39–41] However, Wessel and Williams[40] discovered that learning style was not a significant predictor in the outcome of pretest and posttest scores using the CCTST. Wessel and

Table 4. Independent-Samples Test (Male Versus Female)[a]

	t	df	Significance (2-Tailed)	Mean Difference	SE Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Overall	−1.447	38	.156	−2.978	2.058	−7.144	1.188
Analysis[b]	−1.364	18.233	.189	−3.764	2.760	−9.556	2.029
Inference[b]	−1.347	18.086	.195	−3.429	2.546	−8.776	1.919
Evaluation	−1.156	38	.255	−2.802	2.424	−7.710	2.105
Explanation[b]	−0.761	37.527	.451	−1.940	2.547	−7.098	3.219
Induction	−1.290	38	.205	−2.560	1.985	−6.578	1.458

[a] $\alpha = .05$: equal variances were assumed for Overall, Evaluation, and Induction.
[b] Equal variances was not assumed (Levene test $P < .05$).

Williams[40] used Kolb's[41] learning styles, which included convergers (abstract conceptualization and active experimentation), assimilators (abstract conceptualization and reflective observation), accommodators (concrete experience and active experimentation), and divergers (concrete experience and reflective observation) as their framework for research exploration. Wessel and Williams[40] found no significant differences in CT among learning styles. Although learning styles have not been revealed as a predictor of CT, as measured by the CCTST, pedagogical style may be a factor.

Athletic training programs can foster CT in learning objectives and written assignments, and it has further been concluded that CT should be incorporated into the classroom, as demonstrated in research conducted by Fuller.[6] Presently, the research on pedagogies that promote CT in athletic training is lacking; therefore, we expanded a literature search to include studies in athletic training[5,6,8,42] as well as allied health professions such as nursing.[43–46] In a meta-analysis by Abrami et al,[43] the authors studied various pedagogical strategies, including individual guided study, dialogue (discussion), authentic instruction (problem solving, simulations, etc), and mentoring, used to heighten CT skills. The authors discovered that mentoring in combination with dialogue and authentic instruction was the most advantageous pedagogical approach to encourage CT skills. Furthermore, Profetto-McGrath[44] also discussed the use of problem-based learning, reflective journaling, role modeling, and journal clubs to encourage the development and growth of CT skills. Yet another method of instruction found to facilitate clinical

Table 5. Analysis of Variance of Age Groups[a]

	Sum of Squares	df	Mean Square	F	Significance
Overall					
Between-groups	117.400	3	39.133	0.987	.410
Within-groups	1427.700	36	39.658		
Total	1545.100	39			
Analysis					
Between-groups	184.824	3	61.608	1.158	.339
Within-groups	1914.551	36	53.182		
Total	2099.375	39			
Inference					
Between-groups	165.754	3	55.251	1.238	.310
Within-groups	1606.646	36	44.629		
Total	1772.400	39			
Evaluation					
Between-groups	66.238	3	22.079	0.390	.761
Within-groups	2037.262	36	56.591		
Total	2103.500	39			
Explanation					
Between-groups	182.380	3	60.793	0.763	.522
Within-groups	2868.595	36	79.683		
Total	3050.975	39			
Induction					
Between-groups	47.015	3	15.672	0.410	.747
Within-groups	1374.885	36	38.191		
Total	1421.900	39			

[a] $\alpha = .05$.

Table 6. Analysis of Variance of Parental Education[a]

	Sum of Squares	*df*	Mean Square	*F*	Significance
Overall					
Between-groups	92.296	3	30.765	0.762	.523
Within-groups	1452.804	36	40.356		
Total	1545.100	39			
Analysis					
Between-groups	157.979	3	52.660	0.976	.415
Within-groups	1941.396	36	53.928		
Total	2099.375	39			
Inference					
Between-groups	49.525	3	16.508	0.345	.793
Within-groups	1722.875	36	47.858		
Total	1772.400	39			
Evaluation					
Between-groups	58.701	3	19.567	0.344	.793
Within-groups	2044.799	36	56.800		
Total	2103.500	39			
Explanation					
Between-groups	6.704	3	2.235	0.026	.994
Within-groups	3044.271	36	84.563		
Total	3050.975	39			
Induction					
Between-groups	126.997	3	42.332	1.177	.332
Within-groups	1294.903	36	35.970		
Total	1421.900	39			

[a] $\alpha = .05$.

analytical reasoning (ie, CT) skills was case-based analogical reasoning with cueing,[45] which is a technique whereby faculty members provide students with prompts to provoke retrieval of stored information and memories as well as emotional responses. With case-based analogical reasoning with cueing, the students can learn to process all pieces of information in order to make a clinical decision or judgment.

Furthermore, Abrami et al[46] concluded that improvements in CT skills within a program of study occurred when courses included explicit CT objectives and educators were provided in-service training in preparation for teaching CT skills. Moattari and Abedi[47] further stated that nurse educators must be prepared to implement active, student-centered, collaborative, and problem-focused teaching strategies to foster students' CT. Research in athletic training education[5] suggested that the promotion of truth seeking and reflection to foster CT was also important. Additionally, Finn[39] addressed the connection between evidence-based practice and CT skills, and how CT is essential for evidence-based practice and should be taught early in a professional curriculum.

A literature search was conducted to examine if studies had investigated CT and prerequisite courses. Only 1 dissertation,[48] in nursing, had investigated the relationship between mathematic and scientific prerequisite courses and CT scores. O'Reilly[48] researched accelerated baccalaureate nursing programs and found that rigor for mathematics and science prerequisite courses was a significant predictor of CT scores. Currently, the Commission on Accreditation of Athletic Training Education is investigating prerequisite courses for admission into a master's ATP. Presently, there is no evidence that strongly correlates courses leading to higher CT scores. Although certain pedagogical practices (as mentioned previously) may lead to higher CT scores,[4,6,8,42–46] research investigating gains in CT in relation to specific college courses is lacking. Researchers[49–51] have stated possible gains in CT scores may come from a breadth of general education courses that focus on basic liberal arts and sciences in an integrative fashion. Further research in athletic training education should investigate if CT is positively correlated to prerequisite courses.

Another factor that may affect CT scores in athletic training students is the role of the preceptor. The relationship between the preceptor and CT of allied health care professionals has been investigated.[52–57] Myrick[53] found preceptors' behaviors were integral to the process of enabling students to think critically. A follow-up grounded-theory study by Myrick and Olive[54] determined preceptors behaved in ways (either directly or indirectly) through role modeling, facilitation, guidance, and prioritization that may have contributed to a student's CT. Kaddoura[57] found preceptors could enhance CT skills of students by promoting autonomy, encouragement, case studies, discussions on theory, and availability. It was also found that CT was diminished with students when preceptors controlled patient care and when students felt overwhelmed, had conflicting experiences, or had incompatible personalities. Lastly, Kernan et al[55] surveyed medical students and found factors such as questioning, provision of an appropriate learning environment, and constructive feedback were all ways in which preceptors promoted CT. As a result, studies[52,56] have noted that preceptor training should include teaching-learning strategies and contextual learning interventions that promote CT. Consequently, the research revealed the preceptors' role in the development of the athletic training students' CT skills was significant and should not be underestimated.

As indicated by the aforementioned research, a multidimensional approach may be necessary to teach and evoke CT skills in athletic training students. Of considerable importance, universities, ATPs, and individual faculties use varied pedagogical practices to foster CT. Therefore, our results may not have demonstrated that CT skills improved as a result of gender, age, parental educational level, or degree level, but rather through reflective and varied teaching experiences throughout the athletic training students' education. Furthermore, it could be hypothesized that the inconsistencies in the research of CT skills and athletic training may be attributed to different teaching styles or pedagogical practices among programs. Additional studies in athletic training should investigate the differences of CT, comparing time of matriculation to graduation while looking at pedagogical practices that promote CT.

Although the results from our study do not demonstrate significant differences in CT scores between bachelor's- and master's-degree athletic training students, we believe that many factors may have contributed to the results. Limitations of this study include sample size, region, and motivational influence. The small sample size ($N = 40$) affected the ability to generalize results. Moreover, the sample used for this study may have affected results through purposefully recruiting participants from one NATA district (10), testing athletic training students during their first 6 months in a professional program, and including athletic training students who were enrolled in either a Commission on Accreditation of Athletic Training Education program or a program in candidacy. Additionally, time spent completing the survey and earnestness exercised toward completing the CCTST may have influenced the overall score. We assumed the majority of the athletic training students completing the CCTST took the assessment seriously and completed it to the best of their ability. To finish, we recommend sampling additional populations of athletic training students as well as determining the pedagogical approaches provided by athletic training educators or preceptors to promote CT skills.

CONCLUSIONS

Critical thinking is the intellectually disciplined and purposeful process of seeking relevant information and analyzing and giving appropriate consideration to evidence and its context in order to guide one's beliefs and actions.[3] As discussed, CT has not been sufficiently studied in athletic training; therefore, we investigated CT skills to determine if a difference existed between athletic training students in bachelor's and master's ATPs. Our study revealed there were no differences in CT skills between the 2 groups. Additionally, age, gender, and parental educational level did not have a statistically significant impact on the CT skills of these students. The currently held belief that professional master's-degree students have greater CT skills than bachelor's-degree students was not supported.

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