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Exploring the Progression of University Students' Critical Thinking Skills Across Academic Years

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Abstract: This study aimed to assess and compare the critical thinking skills of university students. The study employed a convenient sampling method for selecting universities, while student participants were chosen randomly. Data were collected from 475 students across five public universities. The Watson Glaser Critical Thinking Appraisal (WGCTA) was utilized to measure participants' critical thinking skills. The research questions were addressed by applying descriptive statistics and one-way ANOVA. The study's outcomes indicated that many university students exhibited a moderate level of CTS. Furthermore, the analysis revealed that the progression in studies had a small effect on the critical thinking skill levels among the students. Policymakers, curriculum developers, teachers, and administrators may learn from the study that they have a role to play in developing the CTS of their students to contribute meaningfully to society. Changes in curriculum, pedagogy, etc., may be possible due to the study's conclusions.

Key Words: University Students, Critical Thinking, Critical Thinking Skills, Progression in Studies

Introduction

Teaching pupils how to think critically and effectively is a fundamental goal of education (Dombayci et al., 2011). Supporting children in developing their capacity for critical thinking fosters the development of this innate ability. They tend to explore unexplored territory to find answers, clarification, and solutions. This intellectual bent motivates individuals to ask pertinent questions, evaluate claims and discussions, and skillfully distinguish between empirical data and subjective perspectives (Pourtaghi et al., 2014).

Learning a lot of facts isn't enough in today's society. The primary goal is to improve pupils' ability to think critically. Students are

now expected to retain information and critically evaluate its relevance and usefulness (Gelder, 2005). Because of this new way of thinking, university students need to learn special skills to handle the flood of information in the present time (O'Neill & Dluhy, 1997). Thinking critically is crucial in many professions, but especially in healthcare. When you exercise critical thinking, you consider all of the relevant factors in making a well-informed decision. Sharples et al. (2017) describe it as a "tool" for facilitating well-informed decision-making.

According to Watson and Glaser (2000), CT is the sum of an individual's intelligence, character, and accomplishments. They also

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think that the ability to perceive, identify assumptions, deduce, interpret, and evaluate logical reasoning are all part of the repertoire of CTS. They state that inductive and deductive reasoning in problem-solving leads to CT, processing, and assessing old information with new information. CT tests frequently used today are based on Watson and Glazer's definition of CT.

When CTS is not incorporated into the classroom, society loses out on significant benefits (Jenkins, 2009). Jenkins said pupils and teachers who don't emphasize CTS hinder their critical thinking ability. He claimed that one of the greatest benefits of intellectual challenge is the stimulation of new ways of thinking. According to Tsui (2002), CTS encourages students to appreciate the value of multiple viewpoints when solving problems and challenges conventional assumptions.

Although the value of teaching CTS in schools has been much discussed, evidence suggests that it should be a central part of any curriculum (Elder & Paul, 2009). It is essential that students leave high school and university equipped with the problem-solving and CTS skills necessary to succeed in a global economy (Law & Kaufhold, 2009). Employers value employees with strong analytical and problem-solving skills (Law & Kaufhold, 2009). This calls for data on how universities and colleges may best prepare their graduates for careers in CT. According to Kirkwood (2003), university students can benefit greatly from CTS to better prepare for life and advocate for themselves and others. According to Healy (1990), critical thinkers are the most important asset to any society and are worth investing time and energy into developing.

CT is a deliberate, rational, and goal-driven approach. Problem-solving, deductive reasoning, probability analysis, and decision-making are all examples of the type of thinking characterized by this term (Akar, 2007). As a guiding tool, CT points the way to answers for societal problems. Educating everyone would be impossible due to the exponential expansion of information. People have to research and

figure out the solutions to their problems. Because of this, CT is beneficial and important.

The development of CTS is seen as the central focus of education. CTS and knowledge are helpful in students' day-to-day lives. On the other hand, it has been noted that most students have trouble addressing problems even at the university level since their CTS are not as well developed as they should be. The present study aimed to determine if there are any significant differences in CTS amongst students majoring in medicine, engineering, information technology, the natural and social sciences, business, and management at Lahore's public universities and medical colleges. The study's findings will show whether or not there is variation.

Evaluating the CTS students cultivate during their academic journey and their practical application in daily life holds immense significance for educational institutions and public policies. As teaching becomes increasingly responsible for student achievements, understanding CTS becomes crucial. Consequently, this research has the potential to provide valuable insights for policymakers, curriculum developers, educators, and administrators who bear the responsibility of nurturing the CTS essential for meaningful societal contributions. The outcomes of this study can facilitate informed adjustments in curricula, teaching methods, etc.

Research Questions

1. What is the overall level of university students critical thinking skills?
2. How do university students' critical thinking skills vary in relation to their abilities in inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments?
3. Do university students' critical thinking skills exhibit variations based on their academic year?

Methodology

A group of elements from which subjects are selected on a specific technique is called a

population (Saeed et al., 2021; Sajjad et al., 2022; Siddique et al., 2022; Siddique et al., 2021). No of the subjects selected from the population is called a sample of the study and data is always collected from the subjects (Faiz et al., 2021; Jabeen et al., 2022; Kanwal et al., 2022; Lakhan et al., 2020; Mah Jabeen et al., 2021; Munir et al., 2021; Siddique et al., 2023; Siddique, et al., 2023; Siddique et al., 2021). The purpose of this study was to create a statistically accurate representation of the population at large by using a survey design. For this study, we selected two public institutions, two medical schools, and one engineering school. A total of 475 students were included in the data-gathering procedure, and they were carefully selected to represent a range of majors and degree stages. There were 312 female participants (65.7%) and 163 male (34.3%) individuals. The researcher visited the schools to collect data in person, where she received responses from 475 out of a possible 600 children.

Instrumentation

The Watson-Glaser Critical Thinking Appraisal (WGCTA) was used to evaluate university students' CTS. The WGCTA is widely used in universities because of its reliability and validity as a standardized tool for assessing CTS. This test has five main sections: inferences, deductions, assumptions, interpretation of information, and argument evaluation. The instructions for the test report a reliability and consistency coefficient of 0.81. Previous studies have also proven the reliability of these evaluation methods in the context of Pakistan.

Scoring and Interpretation of Watson and Glaser CT Appraisal (WGCTA)

Scores on the Watson-Glaser Critical Thinking Appraisal (WGCTA) typically span from 0 to 40, reflecting the average performance of respondents. Scoring below 13 (32.5%) indicates a lack of CTS; scores between 14 to 28 (33 % to 70%) suggest a moderate level of CT, and sores between 29 to 40 (71% to 100%) indicate a high level of CTS.

Table 1

Brief interpretative guidelines for watson and glaser ctappraisal (WGCTA)

Range	Guideline
Below 30.5%	Low level
30.5 % to 70 %	Moderate level
70.5 % to 100 %	High level

Data Analysis

Table 2

Comparative analysis of levels of university students CTS based on WGCTA scores

Variables	Levels		
	Low	Moderate	High
Inference	237(49.9%)	202 (42.5%)	36 (7.6%)
Recognition of Assumptions	7(1.5%)	267(56.2%)	201(42.3%)
Deduction	238(50.1%)	206(43.4%)	31(6.5%)
Interpretation	28(5.9%)	268(56.4%)	179(37.7%)
Evaluation of Arguments	16(3.4%)	266(56%)	193(40.6%)
Overall CT	-	299(62.9%)	176(37.1%)

The results of Table 1 exhibit the lack of use of CTS university students in Deduction (50.1%)

and Inference (49.9%). In contrast, the level of university students CTS was found to be

moderate in Recognition of Assumptions (56.2%), Interpretation of Information (56.4%) and Evaluation of Arguments (56%).

Based on the results, it can be concluded that 62.9% of respondents moderately used their Overall CTS.

Table 3(A)

Analysis of variance in academic years of university students

Variable	Years								ANOVA		
	1 st Year		2 nd Year		3 rd Year		4 th Year		F(3, 471)	p	η^2
	M	SD	M	SD	M	SD	M	SD			
Inference	16.32	3.61	16.60	3.53	16.45	3.40	16.55	3.25	.170	.916	-
Assumption	7.97	2.21	8.62	2.43	8.25	2.46	8.93	2.37	3.214	.023	0.02
Deduction	3.29	1.32	3.58	1.20	3.47	1.36	3.56	1.23	1.443	.229	-
Interpretation	3.50	1.51	4.02	1.47	4.04	1.58	4.05	1.62	4.410	.005	0.02
Evaluation	7.49	2.53	8.42	2.92	8.07	2.87	8.62	2.72	3.912	.009	0.02
O: CT	38.57	6.56	41.24	7.34	40.29	7.19	41.71	6.80	4.888	.002	0.03

The above table displays the outcomes of One-Way ANOVA performed on university students' CTS across multiple academic years. Mean inference scores vary little from one academic year to the next ($F = 0.17$, $p = 0.91$), suggesting that the skill is stable over time. Significant differences exist between academic years in the mean scores for recognizing assumptions ($F = 3.214$, $p = 0.023$). In particular, university students in their second and fourth years outperform their first and third-year counterparts.

Mean scores on deduction have not changed noticeably from one academic year to the next, and the variations across the years are not statistically significant ($F = 1.443$, $p = 0.229$).

Students' mean scores on the interpretation section of the test rise steadily throughout their academic years ($F = 4.410$, $p = 0.005$). The scores of second-, third-, and fourth-year students are often higher than those of first-year students. Significant differences exist in evaluation scores by academic year ($F = 3.912$, $p = 0.009$). Students' performance improves during the second and fourth years compared to the first and third. Students' mean results on CT tests improve over time as they gain experience and knowledge ($F = 4.888$, $p = 0.002$). Overall, students' CT scores improve from first to second to third to fourth year. The effect sizes (η) for the significant differences indicate that while the differences are statistically significant, they have small effect sizes as all η values are between 0.02 and 0.03.

Table 3 (B)

Results of post hoc tukey test for pair-wise comparison among academic years for recognition of assumptions

	(I) Year	(J) Year	Mean Difference (I-J)	p
Recognition of Assumptions	1 st Year	2 nd Year	-.65080	.082
		3 rd Year	-.28169	.749
		4 th Year	-.95686*	.045
	2 nd Year	3 rd Year	.36911	.601
		4 th Year	-.30606	.850
	3 rd Year	4 th Year	-.67517	.294

The post hoc Tukey test was employed to investigate the pairwise comparisons of assumption recognition across academic years, and the results are presented in the above table. When comparing the first and second years, the average difference in assumption recognition was determined to be -0.65, indicating no statistically significant difference between the two groups ($p = 0.08$). When comparing the first and third years, the average difference in the ability to recognize assumptions was found to be -0.28. It's difficult to draw any firm conclusions from this discrepancy ($p = 0.74$). The average recognition of assumptions is -0.95 between the first and fourth years. The difference between the fourth- and first-year students is statistically significant ($p = 0.04$),

suggesting that the fourth-year students can better discern assumptions.

The average gap between the second and third years in terms of making correct assumptions is 0.36. The two groups have no statistically significant difference ($p = 0.60$). When comparing the second and fourth-year university students, the average difference in assumption recognition was -0.30, indicating no statistically significant change ($p = 0.85$). The average difference between the third and fourth-year university students in recognizing assumptions was -0.67. University students in their fourth year tend to be better at recognizing assumptions than those in their third year, while this difference is not statistically significant ($p = 0.29$).

Table 3 (C)

Results of Post Hoc Tukey Test for Pair-wise Comparison among Academic Years for Interpretation

	(I) Year	(J) Year	Mean Difference (I-J)	p
Interpretation	1 st Year	2 nd Year	-.51977*	.019
		3 rd Year	-.53906*	.018
		4 th Year	-.55159	.094
	2 nd Year	3 rd Year	-.01929	1.000
		4 th Year	-.03182	.999
	3 rd Year	4 th Year	-.1253	1.000

Results of a post hoc Tukey test that compared the sub-scale of CTS (Interpretation) are shown in the above table. The mean difference between the first and second academic years students in interpretation is 0.51. This disparity is statistically significant ($p = 0.01$), demonstrating that second-year students outperform first-year students regarding their ability to comprehend data. The mean interpretation difference is -0.53 when comparing the first and third-year students. Students in their third year show considerable improvement in their interpretive skills compared to their first-year selves ($p = 0.01$).

The mean difference in interpretation ability between the first- and fourth-year students is -0.55, indicating a slightly significant difference. The mean difference in

interpretation ability between the second and third years is -0.01. There is no discernible difference in interpretive proficiency between university students of these two years ($p = 1.00$). On comparison of the mean difference in interpretation between the second- and fourth-year students is -0.031. The lack of statistical significance ($p = 0.99$) between the two groups suggests that the levels of interpretive competence in these two school years are similar.

When comparing students in their third and fourth years, the mean difference in interpretation is -0.12. Since there is no statistically significant difference between the two years ($p = 1.00$), it follows that there is also no discernible change in interpretive ability.

Table 3 (D)

Results of post hoc tukey test for pair-wise comparison among academic years for evaluation of arguments

	(I) Year	(J) Year	Mean Difference (I-J)	p
Evaluation of Arguments	1 st Year	2 nd Year	-.93312*	.019
		3 rd Year	-.57610	.299
		4 th Year	-1.12706*	.042
	2 nd Year	3 rd Year	.35702	.734
		4 th Year	.19394	.972
	3 rd Year	4 th Year	-.55095	.609

The above table details the post hoc Tukey test findings, which were conducted to investigate pair-wise comparisons across multiple academic years regarding the Evaluation of Arguments. Comparing the first and second years students, there is a -0.93 mean difference in argument evaluation ability. This statistically significant distinction ($p = 0.01$) suggests that second-year students are better equipped to evaluate arguments than first-year university students. The mean difference in evaluation between the first and third years is -0.57. This distinction, however, is not statistically significant ($p = 0.29$), showing no substantive difference between the two academic years in evaluating arguments.

The mean evaluation difference between the first and fourth years is -1.12. This disparity is statistically significant ($p = 0.04$), suggesting

that fourth-year students significantly outperform first-year students when evaluating arguments. The mean difference in student evaluations in years two and three is 0.35. This difference is not statistically significant ($p = 0.73$), indicating no considerable distinction in evaluating arguments between these two years.

Comparing the 2nd and 4th years, the mean difference in evaluation is 0.19. There is no statistically significant difference between both groups ($p = 0.97$), suggesting that students in both academic years have similar abilities in evaluating arguments. The mean difference between university students' evaluation ability in years three and four is -0.55. There appears to be no discernible change in evaluating arguments between these two academic years, as the difference is not statistically significant ($p = 0.60$).

Table 3 (E)

Results of Post Hoc Tukey Test for Pair-wise Comparison among Academic Years for Overall CTS

	(I) Year	(J) Year	Mean Difference (I-J)	p
Overall CTS	1 st Year	2 nd Year	-2.66846*	.006
		3 rd Year	-1.71175	.171
		4 th Year	-3.13513*	.020
	2 nd Year	3 rd Year	.95671	.698
		4 th Year	-.46667	.976
	3 rd Year	4 th Year	-1.42338	.594

Note: Overall CTS= Overall CTS

The above table displays the outcomes obtained from the post hoc Tukey test, which investigated pair-wise comparisons among

different academic years regarding their Overall CTS.

The mean difference in overall CTS between the 1st and 2nd years is -2.66. This difference is statistically significant ($p = 0.006$), indicating that students in the 2nd year possess better overall CTS than those in the 1st year. When comparing the 1st and 3rd years, the mean difference in overall CTS is -1.71. However, this difference is not statistically significant ($p = 0.17$), suggesting no considerable distinction in overall CTS between these two academic years.

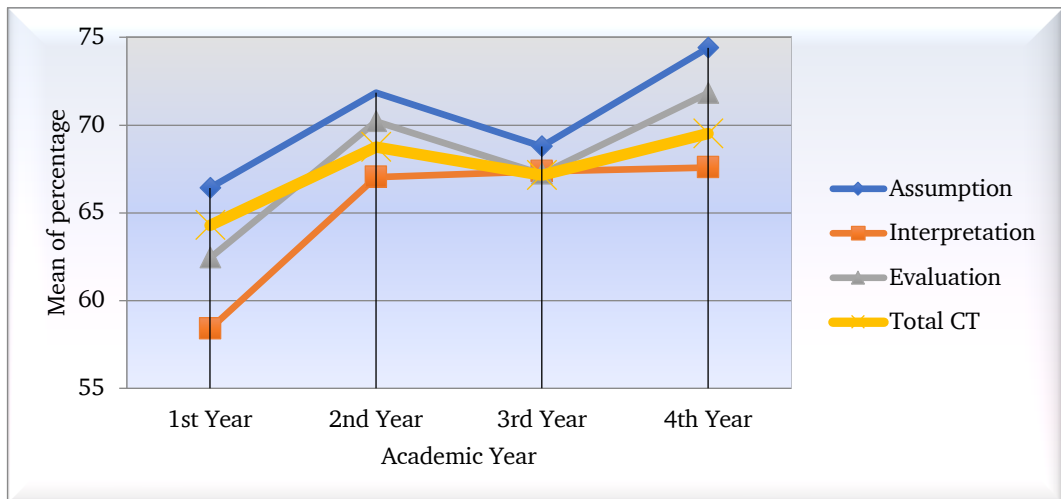
Comparing the 1st and 4th years, the mean difference in overall CTS is -3.13. This difference is statistically significant ($p = 0.02$), implying that students in the 4th year demonstrate enhanced overall critical thinking skills compared to those in the 1st year. The

mean difference in overall CTS between the 2nd and 3rd years is 0.95. This difference is also insignificant ($p = 0.69$), indicating no meaningful distinction between these two years' overall CTS.

Comparing the 2nd and 4th years, the mean difference in overall CTS is -0.46. This difference is not statistically significant ($p = 0.97$), suggesting that students in these academic years possess similar overall CTS. When comparing the 3rd and 4th years, the mean difference in overall CTS is -1.42. This difference is insignificant ($p = 0.59$), indicating no significant discrepancy in overall critical thinking skills between these two academic years.

Figure 1

The mean of percentage of university students for levels of CTS



The line graph above shows the change in CTS of Recognizing Assumption, Interpretation, Evaluation of Arguments and Overall CT in students throughout their academic program of four-year duration.

It is apparent that the university students CTS in the second year significantly improved in Assumption, Evaluation and Total Critical Thinking, while in the next year, a slight downward shift is visible, though significant or

not, as shown in Table 3. Afterwards, in 4th year, these skills improved/restored and reached the altitude significantly improved and greater than in other years, e.g., first, second, and third. Whereas the university students' CTS (Interpretation) in the second year significantly improved and remained stable in the third and fourth years.

Discussion

The university student's level of CTS was found to be "low" in aspects of Deduction and Inference. In contrast, the level of university students CTS was moderate in some aspects, e.g. Interpretation of Information, Recognition of Assumptions, and Evaluation of Arguments.

The outcomes reveal that the majority of university students exhibited a "moderate" utilization of CTS. These outcomes are consistent with a parallel study conducted by (Sendag S. et al., 2015), which showed that the participants' CT was at medium level. Similarly, earlier studies found low or medium-level CT among pre-service teachers CT (Zhou et al., 2012; Yenice, 2011). As a result, it seems reasonable to conclude that the individuals' critical thinking (CT) abilities were below average. This finding agrees with the findings reported by Kürüm (2002). There may not be enough opportunities for students to engage in critical thinking, questioning, and investigating throughout their educational path, which may explain why the outcomes are so similar.

This variance in CTS levels might contribute to the phenomenon observed in our education system, where scholars appear to underutilize their CTS. Our education system focuses more on memorisation than enhancing students' CTS, as per a study conducted by Rashid & Qaisar (2017). In Pakistani institutions, education focuses on rote learning, which means transferring all factual information to students without digging the meaning beneath the surface. Hence, many of our students encounter difficulty comprehending various challenges, whether they pertain to real-world scenarios or involve mathematical and academic complexities. Moreover, it is evident that many university-level students lack the skills to effectively tackle these issues or employ their CTS to address real-life and educational problems.

The CTS of first-, second-, third-, and fourth-year students were shown to vary significantly from one another when compared across academic years. Statistically noteworthy (p.001) variations in mean scores were found between first-, second-, third-, and fourth-year

university students on the CT's three elements (Recognition of Assumption, Interpretation, and Evaluation of Arguments). In contrast, there are no statistically noteworthy variations in mean scores across first-, second-, third-, and fourth-year college students for the three components (Inference and Deduction). Each of the four categories, Assumption, Interpretation, Evaluation, and Overall CT, had a "small" effect size.

From this, we conclude that higher education aids in developing CTS. However, the results are generally unsatisfactory. According to Emir (2012), university students have a moderate level of CT. Therefore, more efforts should be made to improve CT in higher education.

Tukey's HSD multiple-comparison test was used to identify the groups with statistically noteworthy variation. The results show a notable difference between the mean scores of first-year and fourth-year university students on the Recognition of Assumption test, suggesting that senior students are better equipped to spot underlying assumptions than their younger counterparts. These findings are consistent with a study by Burke et al. (2014), which found that fourth-year college students outperformed first-year college students on the Recognition of Assumptions task. The rest of the Recognition of the Assumption comparisons between first-year and fourth-year university students find no statistically significant differences.

University students in their second and third academic years show marked improvement in their ability to interpret information compared to those in their first academic year, as indicated by a statistically noteworthy difference between their mean scores on the Interpretation section of the test. The Interpretation skills of university students regarding different academic years show no statistically notable differences. Further research is needed because no studies compared the outcomes from this angle were found.

The outcomes reveal that concerning the Evaluation of Arguments, significant

differences ($p = 0.019$; $p = 0.042$) in mean scores exist among university students in their 2nd and 4th years compared to those in their 1st year. This underscores that students in the 2nd and 4th years exhibit stronger skills in evaluating arguments than their counterparts in the 1st academic year. However, no statistically noteworthy changes are observed for the remaining comparisons within the Evaluation of Arguments among university students studying across various academic years. Notably, no existing study was identified to provide a comparable perspective on these findings, highlighting the need for further research in this domain.

The outcomes point out that in terms of Overall CTS, noteworthy disparities exist in mean scores among university students enrolled in their 2nd and 4th years with comparison to university students studying in 1st year, which shows that the university students studying in 2nd and 4th year have overall better CTS as compare to the university students studying in 1st academic year. The results of a study conducted by Prat-Sala & Duuren (2020) also support that final-year students exhibit higher CTS than those in the 2nd and 3rd academic years.

The results of the line graph show the change in CTS of Recognizing Assumption, Interpretation, Evaluation of Arguments and Overall CTin students throughout their academic program of four-year duration.

It is apparent that the university students CTS in the second year significantly improved in Assumption, Evaluation and Total Critical Thinking, while in the next year, a slight downward shift is visible though significant or not, as shown in Table no 3. Afterwards, in 4th year, these skills improved/restored and reached the altitude significantly improved and more remarkable than in other years, e.g., first, second, and third. Whereas the university students' CTS (Interpretation) in the second year significantly improved and remained stable in the third and fourth years. Similar

findings were found in studies conducted with university students by Akar (2007) and Gülveren (2007). Their consequences revealed that the CTS of students in their first and second years were superior, but as students progressed through their academic years, there was a decline in the quality of their CTS.

Recommendations

Considering the findings and outcomes of this study, the following recommendations are proposed to enhance the CTS of university students across various four-year programs:

1. Incorporate additional activities within courses to bolster CTS development. Doing so may give students more opportunities to engage in critical reading, writing, listening, observing, and communication techniques.
2. Faculty members within education faculties should design and implement suitable activities that aid students in refining their CTS. Exploring the factors influencing CTS and the pathways through which these factors impact students should be the focus of more comprehensive studies utilizing diverse assessment tools.
3. Enhance education programs with information and strategies for fostering CTS. Efforts can be directed at raising parental awareness regarding nurturing their children's CTS. Additionally, initiatives can be designed to demonstrate to pre-university students the application of CTS within academic contexts and everyday life.
4. Educators should receive comprehensive training on instructing CTS. This training should encompass methods, techniques, and approaches for teaching CT during their pre-service education and throughout their professional careers. This equips them to impart critical thinking skills effectively to their students.

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