Research

This open-access article is distributed under Creative Commons licence CC-BY-NC 4.0.

Do critical thinking skills develop in undergraduate health professions students in a one-year period?

M Louw,[1] BSc (Physiotherapy), M (HPE); **C Van Wyk,**[2] MSc (Med), PhD (HPE)

[1] *Department of Physiotherapy, Faculty of Health Sciences, University of the Free State, Bloemfontein, South Africa*
[2] *Genetics and Genomics Department, College of Medicine and Health Sciences, United Arab Emirates University, Al Ain, Abu Dhabi, United Arab Emirates*

Corresponding author: *M Louw (LouwM@ufs.ac.za)*

Background. Critical thinking (CT) is a core competency in health professions education, supporting clinical reasoning, judgement and decision-making in complex clinical environments. Evidence suggests that CT does not consistently develop through undergraduate training alone, particularly in resource-constrained settings. Limited data exist on short-term CT development within a single academic year among undergraduate health professions students.
Objective. To determine whether CT skills develop in undergraduate health professions students over one academic year.
Methods. A one-group pretest–post-test design was used for this quantitative study involving third- and fourth-year undergraduate students in the School of Health and Rehabilitation Sciences at a South African university. CT skills were assessed using a modified Thinking Skills Assessment (TSA). Median pretest and post-test scores were compared using the signed-rank test, and changes in CT scores were analysed using non-parametric statistical methods.
Results. A total of 106 students completed both assessments. Overall CT skills remained stable over one academic year, with no statistically significant improvement in CT skills. A discipline-specific pattern emerged: occupational therapy students demonstrated a significant increase in median scores compared with other groups (p=0.04), suggesting that particular contextual or curricular factors may influence CT development.
Conclusion. The findings challenge the assumption that CT skills naturally progress during undergraduate training and highlight the importance of discipline-specific factors. The gains observed in occupational therapy students warrant further investigation into curricular, pedagogical or assessment factors that drive this difference. Longitudinal research and triangulated assessment approaches are needed to determine CT trajectory and inform curriculum refinement aimed at strengthening CT across health professions programmes.

Keywords: critical thinking skills, health professional, graduate attributes, Thinking Skills Assessment (TSA)

Afr J Health Professions Educ 2026;18(3):1409. https://doi.org/10.7196/AJHPE.2026.v18i3.1409

Critical thinking (CT) is a core graduate attribute in health professions education, as it underpins clinical reasoning, supports sound clinical judgement and facilitates timely decision-making in patient care.[1] Although CT is a multifaceted construct with no single universally accepted definition, it is generally understood to involve purposeful, analytical and reflective thinking that guides action in a complex clinical environment. The Association of American Colleges and Universities defines CT as 'a habit of mind characterised by the comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating an opinion or conclusion,'[2] emphasising both skill and disposition components of the construct. Despite this broad conceptualisation, CT undergraduate training remains challenging to define, teach and measure consistently.[3]

Emerging evidence suggests that CT skills and dispositions do not develop naturally during undergraduate training.[4] Studies report gaps in areas such as numeracy, analysis and truth-seeking, challenging assumptions that clinical exposure alone is sufficient to foster CT development.[1,5] In South Africa (SA), similar concerns are reflected in undergraduate health professions programmes, where students often enter clinical environments in their third year of study without the CT capacity needed to make independent, safe decisions. This is further intensified in many SA training sites that operate under resource-constrained conditions, where limited equipment, high patient loads and variable supervision require students to demonstrate adaptive problem-solving and strong CT skills to ensure quality patient care.[6] As students transition from preclinical to clinical training, they are expected to integrate foundational knowledge into clinical reasoning that informs real-world decisions.[7] This integration requires increasingly strong levels of CT, underscoring the importance of explicitly supporting CT development within undergraduate curricula.[1,5]

Existing research shows a correlation between CT skills, clinical reasoning[8] and academic success,[9] highlighting the relevance of CT for both educational progress and professional competence. Pedagogical strategies such as problem-based learning, concept mapping, simulation-based learning and digital learning interventions show promise for enhancing CT[10]; however, evidence of their sustained effect over time, particularly in undergraduate programmes, is scarce. Few studies have examined whether CT meaningfully improves over one single academic year, leaving a gap in understanding the natural trajectory of CT development in early training.

Measurement adds an additional layer of complexity. Although standardised CT assessment tools exist,[11] such as the California Critical Thinking Skills Test (CCTST), the California Critical Thinking Disposition Inventory (CCTDI) and the Health Sciences Reasoning Test (HSRT), there is no universally accepted instrument that aligns with the discipline-specific CT demands of different health professions. This limits the ability of programmes to evaluate CT growth longitudinally or to make evidence-based curriculum adjustments.[9,12] A further challenge in low- and middle-income countries such as SA is the high cost of commercially available

tools, making routine or annual CT assessments financially unrealistic and difficult to sustain at scale.

Against this backdrop, this study aimed to determine whether CT skills in undergraduate health professions students change over the course of one academic year. By analysing findings from a local cohort, we explored the extent to which CT develops naturally within the curriculum and consider the implications for teaching strategies, curriculum design and early identification of students who may require additional support.

Methods

A quantitative, pretest–post-test design was used to examine changes in CT skills over one academic year in undergraduate health professions students. The study was conducted within the School of Health and Rehabilitation Sciences at an SA university. Eligible participants (N=227) were third- and fourth-year undergraduate students enrolled in physiotherapy (PT), nutrition and dietetics (ND), optometry (OP) and occupational therapy (OT) in 2018. Participation was voluntary, and neither academic nor financial incentives were offered. The inclusion criteria comprised registered students in the specific programmes and their year of study; no exclusion criteria beyond non-participation were applied. The same cohort was invited, through the class representative, to complete both the pretest and post-test.

CT was measured using a specimen version of the Thinking Skills Assessment (TSA) developed by the University of Cambridge Local Examinations Syndicate (UCLES) for university admissions. The TSA comprises items designed to assess core CT and problem-solving abilities using a discipline-neutral format. For this study, only the 25 multiple-choice CT items were administered, to align with the research focus on CT skills development.

With permission from Cambridge Assessment Admissions Testing to use the specimen TSA (UCLES 2015 version), minor terminology adaptations (Table 1) were made to enhance contextual relevance for SA students; the structure, item stems and correct responses remained unchanged. The adapted instrument is referred to as the Modified-TSA in this article. The TSA was selected for its construct alignment (CT and problem solving), suitability for mixed-cohort health professions students and feasibility for repeated use in resource-constrained settings.

Data collection occurred at two time points within the same academic year: pretest in January 2018 and post-test in September 2018. The post-test was scheduled after completion of all clinical block rotations and before final examinations. Tests were administered in a paper-and-pen format in invigilated venues under standardised test conditions (e.g. a quiet environment). A trained fieldworker distributed and collected the test papers, monitored timing (60 minutes) and ensured consistent administration across sittings. Each student was assigned a unique nine-digit participant code to ensure anonymity throughout the data collection and analysis process.

Ethical approval was obtained from the Health Sciences Research Ethics Committee of the Faculty of Health Sciences at the University of the Free State (UFS-HSD2017/1276). The study posed minimal risk, with no anticipated physical or psychological harm to participants. A pilot test was carried out in 2017 with one fourth-year student from each cohort to evaluate face validity. No changes to the instrument were required, and the pilot participants were excluded from the final study sample.

Responses were captured into a Microsoft Excel spreadsheet and verified prior to analysis. The Department of Biostatistics (UFS) analysed the final data using SAS Version 9.1. CT items were scored 1 for correct and 0 for incorrect, and total CT scores were computed for each participant at each time point.

Results

A total of 136 students (59.9% of the population) completed the pretest, and 106 students (46.7% of the population) completed both the pretest and the post-test. Across the pretest to post-test, there were no statistically significant changes in total CT scores. Median scores at the different group levels remained stable (Table 2), and the sign-rank tests indicated non-significant differences in total CT scores within each profession (p>0.05).

To explore cohort effects, third- and fourth-year students were analysed separately. Median CT scores for both years were 11 at pretest and post-test, with a minimum, non-significant positive development, to 12 and 12.5, respectively.

When stratified by department (PT, ND, OP and OT), no profession demonstrated a statistically significant (p<0.05) improvement in CT scores from pretest to post-test. The OT cohort had a higher median score than the other departments at both pretest and post-test, yet exhibited negative growth over the timeframe (Table 2).

Based on TSA 2015 guidance, CT performance was classified as weak (<10), average (11 - 15) and strong (>16), with a maximum score of 25. The majority of the students fell within the average classification at both pretest and post-test, across departments and year groups (Table 3). The test results remained unchanged for 71 students (66.98%), with most of the students scoring in the weak and average category.

The direction of change in the results of the Modified-TSA for the total group indicated that 40.57% of the student population who completed

Table 1. Components of the Modified-TSA used in this study

TSA component	Question number	Number of items	Examples of terminology changed
Apply principles	1, 14	2	Q1 - Miles to kilometres (km)
Summarise the main conclusion	5, 7, 12, 18, 24	5	Q7 - Widgett and Co to De Beers Mining
Draw a conclusion	11, 13, 17	3	
Identify assumptions	3, 4, 8, 21, 25	5	Q3 - England to Bloemfontein Q8 - Britain to SA
Assess the impact of additional evidence	10, 20, 22	3	
Detect reasoning errors	2, 6, 9, 15, 19	5	Q2 - Britain to SA
Match arguments	16, 23	2	Q16 - London marathon race to Comrades marathon race
Total		25	

the test showed an increase in CT skills on the Modified-TSA, while 15.09% had no change in their scores (Table 4). The third- and fourth-year groups were then separated from the total group to determine if there was a difference in the change in CT between the third- and fourth-year groups. A χ^2 test comparing direction of change (increase, decrease or no change) between year groups showed no statistically significant difference (p=0.88), suggesting comparable trajectories of CT scores across the academic year (Table 4).

Discussion

Across the cohort, overall CT scores remained stable over one academic year, with no significant group-level changes on the Modified-TSA. The third- and fourth-year students had comparable median scores, suggesting that exposure to clinical rotations alone did not translate into measurable CT growth within the observed timeframe. An exception was OT, where students demonstrated higher median scores at both the pretests and post-tests, relative to other cohorts, although the change during the year was negative.

The absence of short-term improvement is consistent with findings over brief intervals in health professions education. A meta-analysis demonstrated mixed findings with standardised CT assessment tools such as CCTST and HSRT. The CCTST showed small but significant gains over time, while the HSRT did not detect meaningful change, suggesting instrument-dependent sensitivity to change.[12] These mixed outcomes have been attributed to heterogeneity in CT conceptualisation, measurement tools, programme structures and student cohorts, as well as contextual variations between high-income and resource-constrained settings.

Interpreting the findings requires considering key contextual differences between this study and previous work, namely participant education level (undergraduate v. postgraduate), country, curricula, assessment tools and duration of observation. Firstly, these variables can significantly alter baseline CT levels and observed growth, making direct comparisons difficult without accounting for the population. This study focused on SA undergraduates at a single institution, whereas other studies have focused on postgraduate students with more advanced academic and clinical exposure. Secondly, this study made use of a modified version of the TSA, whereas other studies used instruments with different constructs, score ranges and sensitivities. This heterogeneity in the instrument can produce different distributions and effect sizes. Thirdly, the time frame of an annual interval is shorter than the studies following students over a period of 27 months or the entire undergraduate programme duration, which increases the chances of detecting cumulative gains.[13,14]

The third- and fourth-year students had comparable median scores, suggesting that exposure to clinical rotations alone did not translate into measurable CT growth within the observed timeframe. This finding contrasts with expectations that CT develops as students' progress through the academic programme and begin to integrate the theoretical knowledge with the practical application through increasingly complex clinical problem-solving.[15] Literature typically captures the longitudinal, cumulative

Table 2. Results per year group and per profession

	Median		Differences	Maximum score		Minimum score		*p*-value
	Pre	Post		Pre	Post	Pre	Post	
PT 4 (*n*=33)	11	12	+1	18	18	6	6	0.31
PT 3 (*n*=25)	11	12	+1	22	18	4	6	0.11
OT3 (*n*=15)	15	14	-1	21	19	7	9	0.04*
ND4 (*n*=7)	11	12	+1	16	15	8	9	0.22
ND3 (*n*=11)	11	10	-1	19	18	8	7	0.86
OP4 (*n*=12)	12	11	-1	19	21	9	5	0.26
OP3 (*n*=3)	10	11	+1	15	11	6	2	0.50

*p<0.05. PT = physiotherapy; OT = occupational therapy; ND = nutrition and dietetics.

Table 3. Classification of the Modified-TSA total scores per year group and profession

	Weak (<10)			Average (11 - 15)			Strong (>16)		
	Pre	Post	No change	Pre	Post	No change	Pre	Post	No change
PT4	13	14	9	15	14	7	5	5	2
ND4	2	6	2	7	4	2	3	2	1
OP4	3	3	1	3	3	2	1	1	2
PT3	12	11	10	11	11	9	2	3	2
OT3	1	1	1	7	9	7	7	5	5
ND3	4	6	3	6	4	3	1	1	1
OP3	2	1	1	1	2	1	0	0	0
Total score (%)	37 (34.9)	42 (39.6)	27 (25.5)	50 (47.2)	47 (44.3)	31 (29.2)	19 (17.9)	17 (16)	13 (12.3)

Table 4. Direction of change according to the results on the Modified-TSA test total results (from pretest to post-test)

Change	Total group	Third-year group		Fourth-year group	
	f (%)	f (% of group)	% of total group	f (% of group)	% of total group
Increase	43 (40.57)	22 (40.74)	20.75	21 (40.38)	19.81
Decrease	47 (44.34)	23 (42.59)	21.7	24 (46.15)	22.64
No change	16 (15.09)	9 (16.67)	8.5	7 (13.46)	6.6
Total	106 (100)	54 (100)	50.95	52 (100)	49.05

f = frequency; % = percentage.

effects of curricula, including repeated assessments, scaffolding learning opportunities and progressive clinical immersion, conditions that are not fully replicated within the single academic year examined in this study. Evidence from a systematic review suggests that pedagogical approaches, such as simulation, structured clinical discussions, cognitive scaffolding and reflective practices, are generally implemented over extended periods and embedded across multiple learning contexts.[5] Moreover, studies report stronger associations between clinical exposure and CT development that incorporate CT pedagogy strategies, playing a critical role in linking practical experience with higher-order cognitive development.[16]

Minimal, non-significant median improvements in four of the year group subsets on the Modified-TSA correlate with other research findings.[1,12] OT students demonstrated a higher median score on both the pretest and post-test compared with the other cohorts, despite a slight negative change during the timeframe. This finding is consistent with previous research.[17] Several contextual factors might explain this pattern. Curricular differences may partly explain this finding, as OT students at this institution begin clinical exposure in their first year of study. The curricula often include active instructional methods that foster CT, which may align with constructs tested using the Modified-TSA.[18] The OT cohort was limited to third-year students, raising the possibility that cohort-specific characteristics may drive higher baseline scores. A factor could be that the Modified-TSA captured dimensions that are particularly salient in the OT curricula, relative to other programmes. These hypotheses warrant a deeper investigation into the different OT cohorts and cross-departmental curricular mapping to identify curricular features associated with stronger CT performance. Further research is needed in this area and cohort to determine the generality and the need for curriculum adjustments to ensure the development of well-rounded health professionals who are successful in their careers. The implementation of focused CT skills development programmes[7] and a longer testing timeframe[19] may provide valuable information and could be the focus of future research, as CT skills programmes have been found to meaningfully increase CT skills in vulnerable students.[20]

The researcher identified several limitations, the first of which is that this study was conducted at a single institution, with a limited sample size and a 1-year follow-up, which constrains generalisability. Moreover, student workload, motivation[21] and cognitive fatigue[13] are plausible moderators of performance on standardised CT tools. Future research should track cohort CT skills from first to fourth year to capture the cumulative development of CT skills and identify critical points of growth. This will provide a bigger picture of where the development of CT takes place. The differences in curricula across various healthcare professions should also be explored in more detail to determine why OT undergraduate students had a significantly higher median test score. It might also be valuable to compare the Modified-TSA with other valid and reliable CT skills tests to determine the scalability of this test in low-resourced settings.

Conclusion

Across this cohort of undergraduate SA health professions students, CT skills remained stable over the course of one academic year, with average median scores on the Modified-TSA scores, and no significant group-level changes were observed. This stability suggests that CT skills may not develop spontaneously through standard academic progression or clinical exposure alone. Instead, CT is likely a slow-developing, instruction-sensitive cognitive skill that requires deliberate pedagogical support, structured opportunities for reasoning and intentional curriculum design.

The significant improvement in OT students indicates the need for discipline-specific curriculum mapping to explore programme-specific level differences. These findings underscore the need to identify or develop CT assessment tools that are appropriately validated for undergraduate health professions contexts, as well as to map curricular structures to determine when and how CT development is expected to occur in a curriculum. Future research would benefit from longitudinal designs, targeted CT-focused pedagogical interventions and triangulation across multiple assessment instruments, to precisely characterise CT trajectories and inform curriculum refinement aimed at strengthening clinical reasoning.

Although this study was limited by the underrepresentation of fourth-year OT students and the use of commercially developed CT measurement tools that were not fully contextualised for SA students, it highlights the need to more intentionally embed CT strategies across undergraduate training. Strengthening early and ongoing CT instructions may contribute to improved clinical reasoning, better educational outcomes and, ultimately, enhanced healthcare practices and patient care.

Data availability statement. Data are available from the corresponding author on reasonable request, subject to ethical and institutional requirements.

Declaration. None.

Acknowledgements. Artificial intelligence(AI) -assisted tools (Microsoft Copilot) were used solely to improve grammar, clarity and organisation of the manuscript. No content, data interpretation, analysis or conclusions were generated by AI. All intellectual work was conducted, verified and approved by the authors.

Author contributions. ML conducted the research as part of her master's degree, including data collection, data analysis, interpretation of the findings and preparation of the original manuscript. CvW was the principal supervisor and contributed to the conceptualisation of the study, obtaining of institutional and ethics approvals, supervision of the research process, oversight of the data analysis and manuscript preparation, and critical review and revision of the manuscript. Both authors approved the final version of the manuscript.

Funding. This work was supported financially by the Health and Welfare Sector Education and Training Authority (HWSETA).

Conflicts of interest. None.

1. Dissen A. A critical issue: Assessing the critical thinking skills and dispositions of undergraduate health science students. Discover Educ 2023;2(21). https://doi.org/10.1007/s44217-023-00044-z
2. Association of American Colleges & Universities. VALUE Rubrics – Critical thinking 2010. https://www.aacu.org/value/rubrics/critical-thinking (accessed 8 January 2026).
3. Berg C, Philipp R, Taff SD. Scoping review of critical thinking literature in healthcare education. Occup Ther Health Care 2023;37(1):18-39. https://doi.org/10.1080/07380577.2021.1879411
4. Zhai J, Zhang H. Critical thinking disposition of medical students in Anhui Province, China: A cross-sectional investigation. BMC Med Educ 2023;23:652. https://doi.org/10.1186/s12909-023-04646-x
5. Sims D, Zingela Z, Mokhachane M, et al. Medical education, reflections and perspectives from South Africa: A review. BMC Med Educ 2025;25:370. https://doi.org/10.1186/s12909-025-06910-8
6. Talberg H, Camroodien-Surve F, Amosun SL. Understanding of clinical reasoning by undergraduate students and clinical educators in health and rehabilitation sciences at a South African University: The implications for teaching practice. Afr J Health Prof Educ 2021;13(4):240-245. https://doi.org/10.7196/AJHPE.2021.v13i4.1293
7. Araújo B, Gomes SF, Ribeiro L. Critical thinking pedagogical practices in medical education: A systematic review. Front Med 2024;11:1358444. https://doi.org/10.3389/fmed.2024.1358444
8. Richards JB, Hayes MM, Schwartzstein RM. Teaching clinical reasoning and critical thinking: From cognitive theory to practical application. Chest 2020;158(4):1617-1628. https://doi.org/10.1016/j.chest.2020.05.525
9. Ross D, Loeffler K, Schipper S, Vandermeer B, Allan GM. Do scores on three commonly used measures of critical thinking correlate with academic success of health professions trainees? A systematic review and meta-analysis. Acad Med 2013; 88(5):724-734. https://doi.org/10.1097/ACM.0b013e31828b0823
10. Payan-Carreira R, Cruz G, Papathanasiou IV, Fradelos E, Jiang L. The effectiveness of critical thinking instructional strategies in health professions education: A systematic review. Stud High Educ 2019;44(5):829-843. http://doi.org/10.1080/03075079.2019.1586330

11. Alias A, Mohtar LE, Ayop SK, Rahim FR. A systematic review on instruments to assess critical thinking & problem-solving skills. EDUCATUM J Sci Math Technol 2022;9:38-47. https://doi.org/10.37134/ejsmt.vol9.sp.5.2022
12. Reale MC, Riche DM, Witt BA, Baker WL, Peeters MJ. Development of critical thinking in health professions education: A meta-analysis of longitudinal studies. Curr Pharm Teach Learn 2018;10(7):826-833. https://doi.org/10.1016/j.cptl.2018.04.019
13. Domenech MA, Watkins P. Critical thinking and disposition toward critical thinking among physical therapy students. J Allied Health 2015;44(4):195-200.
14. Vendrely A. Critical thinking skills during a physical therapist professional education program. J Phys Ther Educ 2005;19(1):55-59. https://doi.org/10.1097/00001416-200501000-00007
15. Jimenez JM, Lopez M, Castro MJ, Martin-Gil B, Cao MJ, Fernandez-Castro M. Development of critical thinking skills of undergraduate students throughout the 4 years of nursing degree at a public university in Spain: A descriptive study. BMJ Open 2021;11:e049950. https://doi.org/10.1136/bmjopen-2021-049950
16. Wang L, He LH, Wan JH. Implementation of a guideline-based clinical practice teaching model to enhance learning and thinking abilities in undergraduate nursing students. BMC Nurs 2025;24:572. https://doi.org/10.1186/s12912-025-03183-w
17. Vogel KA, Geelhoed M, Grice KO, Murphy D. Do occupational therapy and physical therapy curricula teach critical thinking skills? J Allied Health 2009;38(3): 152-157.
18. Pitonyak JS, Nielsen S, O'Brien SP, Corsilles-Sy C, Lambert DO, Jaffe LE. Critical thinking in occupational therapy education: A systematic mapping review. J Occup Ther Educ 2020;4(4). https://doi.org/10.26681/jote.2020.040403
19. Brudvig TJ, Mattson DJ, Guarino AJ. Critical thinking skills and learning styles in physical therapists trained in India enrolled in a master's program. J Phys Ther Educ 2015;29(4):5-13. https://doi.org/10.1097/00001416-201529040-00003
20. Romero Uscanga RR, Torres-Delgado G. Impact of the development of critical thinking skills and academic development of vulnerable students during confinement due to COVID-19. In: Proceedings of the 2022 13th ACM International Conference on E-Education, E-Business, E-Management and E-Learning (IC4E); 2022; January 14-17:Tokyo, Japan. New York: ACM;2022:143-153. https://doi.org/10.1145/3514262.3514272
21. Bensley DA, Rainey C, Murtagh MP, et al. Closing the assessment loop on critical thinking: The challenges of multidimensional testing and low test-taking motivation. Think Ski Creat 2016; 21:158-168. https://doi.org/10.1016/j.tsc.2016.06.006

Received 16 August 2023; accepted 24 July 2026.