

Cooperative learning - A vehicle to develop clinical reasoning skills

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Background. Clinical reasoning is a critical skill that nursing practitioners must develop. Positive patient outcomes have been linked to nurses with clinical reasoning skills. While experienced nurse practitioners often demonstrate clinical reasoning skills, evidence shows that these skills can be taught and mastered, even by less experienced nurses.

Objective. To determine whether a cooperative clinical reasoning activity can aid nursing students in developing their clinical reasoning skills.

Methods. A quasi-experimental, non-equivalent, pre-test-post-test control group method was used, employing an Outcome-present-state (OPT) worksheet and a marking rubric to assess the results. The study population consisted of 208 final-year nursing students who were purposively assigned to either the experimental group ($n=84$) or the control group ($n=124$).

Results. Participants in the experimental group showed higher clinical reasoning scores after engaging in cooperative clinical reasoning activities, compared with participants in the control group who did not participate ($p=0.07$).

Conclusion. Clinical reasoning is a skill that can be developed through the deliberate inclusion of targeted activities in a nursing programme.

Keywords. Clinical reasoning; nursing students; nursing education.

Afr J Health Professions Educ 2025;17(1):e1642. <https://doi.org/10.7196/AJHPE.2025.v17i1.1642>

In the realm of healthcare, higher-order cognitive skills are paramount, encompassing critical thinking, problem-solving (clinical reasoning) and decision-making (clinical judgment).^[1] While these terms are frequently interchanged, they signify distinct cognitive processes that synergistically empower healthcare professionals, including nurses, to deliver proficient care.^[2] The core of clinical reasoning lies in the cognitive procedure of interpreting and analysing patient data, acknowledging actual and potential health difficulties and crafting effective solutions to address these concerns.^[3] To cultivate these indispensable cognitive proficiencies, students require guidance from educational stakeholders, both in clinical practice and academic settings. In this context, the proven pedagogical technique of cooperative learning emerges as a beacon, permeating diverse educational domains,^[4] strengthening the acquisition of these competencies through dynamic student engagement and collaborative efforts.

Cooperative learning, as articulated by Johnson *et al.*,^[4] involves students uniting their efforts towards shared educational objectives. The fusion of this approach with teaching and learning paradigms^[5-7] could carry considerable benefits for nursing students in enhancing their clinical reasoning competency, amidst real-world clinical settings.

Clinical reasoning stands as an indispensable aptitude requisite for nurses tending to patients.^[8] This attribute stands as a requirement for fostering positive patient outcomes, yet its deficiency can precipitate unfavourable patient incidents.^[9,10] Therefore, nursing education institutions (NEIs) shoulder the responsibility of nurturing nursing students in these imperative skills including clinical reasoning.^[10] However, the contemporary clinical landscape often presents newly graduated nurses with hurdles, as they grapple with the intricacies of real-world scenarios, despite their theoretical exposure.^[11] Several factors hinder the development of their clinical reasoning skills during experiential learning

moments. Some of these factors include nurse shortages, reduced patient hospitalisation days, fewer admissions to acute care facilities and a focus on repetitive tasks and skill assessments. The cumulative impact of these influences translates to inadequate support for nursing students, both from clinical practice and their mentors, hampering the maturation of their clinical reasoning abilities. There is an innovative pedagogical intervention called the Cooperative Clinical Reasoning Activity (CCRA).^[13] This article aims to describe the potential of the CCRA to positively transform nursing students' clinical reasoning abilities, ultimately improving the quality of nursing care they provide.

Methods

A quasi-experimental, non-equivalent, pre-test-post-test control group design was used to compare the performance of nursing students who engaged in a developed CCRA with those who received traditional facilitation approaches. The design was selected as the most appropriate approach, given that random assignment of nursing students to the control and experimental groups was not possible owing to their distribution across multiple campuses.

Ethical considerations

The study obtained ethical approval from the custodian university, the University of South Africa (UNISA) (Ref. no. HSHDC/893/2019). Permission to conduct the study was obtained from the private hospital group's ethics committee (Ref. no. REC 251015-048). Special approval to implement the CCRA intervention for the students in the experimental group as a component of their course was granted by the Institution's Education Manager. Participants received recruitment letters and were given the opportunity to participate voluntarily.

Study procedure

In this study, the target population comprised 208 final-year nursing students enrolled in a two-year bridging course to qualify as registered nurses (R683). Students were purposefully assigned to either the experimental group ($n=84$) or the control group ($n=124$). Total population sampling was used for the pre- and post-tests, inviting all final-year students to participate. However, some students in the experimental group were excluded based on predetermined criteria. These excluded students were reassigned to the control group. The exclusion criteria applied were as follows:

- Where there were less than two students placed in a facility to form small groups.
- Where there was no clinical facilitator (CF) available to coordinate the intervention.
- Students who failed their first-year exam and were therefore not in their final year.

Two students were excluded because of insufficient numbers of students placed in the clinical facility. Additionally, 18 students were excluded because a CF was not available to coordinate the intervention. Lastly, seven students were excluded for failing the first year of the course. In total, twenty-seven students were excluded from the experimental group and added to the control group. Table 1 outlines the inclusion and exclusion criteria applied to the experimental group.

A total number of 57 students, included in the experimental group for implementation of the CCRA were divided into 18 groups. These 18 groups were allocated to 13 hospitals, as some larger hospitals had more than one group. The participants who were excluded were reassigned to the control group ($124 + 27 = 151$).

Data were collected over a nine-month period using an Outcome-present state (OPT) marking rubric, following participants' completion of an OPT worksheet. All participants completed the OPT worksheet with a

standardised case study as a pre-test at the commencement of their final year. The experimental group participated in the intervention, completing four CCRAs, after which all participants completed a post-test at the end of the final year using the same standardised case study (Fig. 1).

The OPT model is a third-generation nursing process meta-model, designed to assist students in planning and evaluating care.^[14] It has been tested and validated as a reliable tool for measuring nursing students' clinical reasoning skills.^[14] It was used in this study to determine participants' clinical reasoning skills at the start of the programme (pre-test) and at its conclusion (post-test) to evaluate the development of their clinical reasoning skills.

The OPT worksheet consisted of a reasoning web and an OPT frame. Using a standardised case study, participants used the reasoning web to identify a priority nursing problem, which then guided the completion of the OPT frame. The OPT frame supported participants in evaluating the potential impact of the planned nursing care on the patient's present state and whether the anticipated outcomes would be achieved. Once completed, the reasoning web and OPT frame were marked using an adapted OPT marking rubric. The marking rubric was modified with the permission of Prof Ruth Kuiper, one of the OPT developers, to suit the South African (SA) context.

A total of 174 participants completed the OPT worksheets (83.6% response rate); however, 28 participants were excluded from the analysis owing to incomplete information on the OPT worksheet. The total that could be included for analysis was 146.

The intervention (CCRA) was administered to all participants in the experimental group ($n=57$) while they were placed in the hospitals for their clinical practical. They had to participate in four CCRAs, spaced out throughout their final year. The CCRA was developed and validated by Neethling,^[13] with the aim of facilitating the development of nursing students' clinical reasoning skills by working cooperatively with the participants in

Table 1. Summary of the inclusion and exclusion criteria

Facility	Exclusion criteria			Excluded/ Included	Groups participating	
	Students placed at the hospital, N	Facilitator available	Failed 1st year exam		(3 - 4 students per group), N	Participating students, N
1	2	Yes	1	Excluded	0	0
2	14	Yes	-	Included	4	14
3	4	Yes	1	Included	1	3
4	3	No	-	Excluded	0	0
5	5	No	-	Excluded	0	0
6	4	Yes	-	Included	1	4
7	2	Yes	-	Included	1	2
8	7	Yes	3	Included	1	4
9	10	No	-	Excluded	0	0
10	1	Yes	-	Excluded	0	0
11	2	Yes	-	Included	1	2
12	2	Yes	-	Included	1	2
13	7	Yes	-	Included	2	7
14	3	Yes	-	Included	1	3
15	8	Yes	1	Included	2	7
16	3	Yes	-	Included	1	3
17	2	Yes	-	Included	1	2
18	5	Yes	1	Included	1	4
Totals	84	13	7	13	18	57

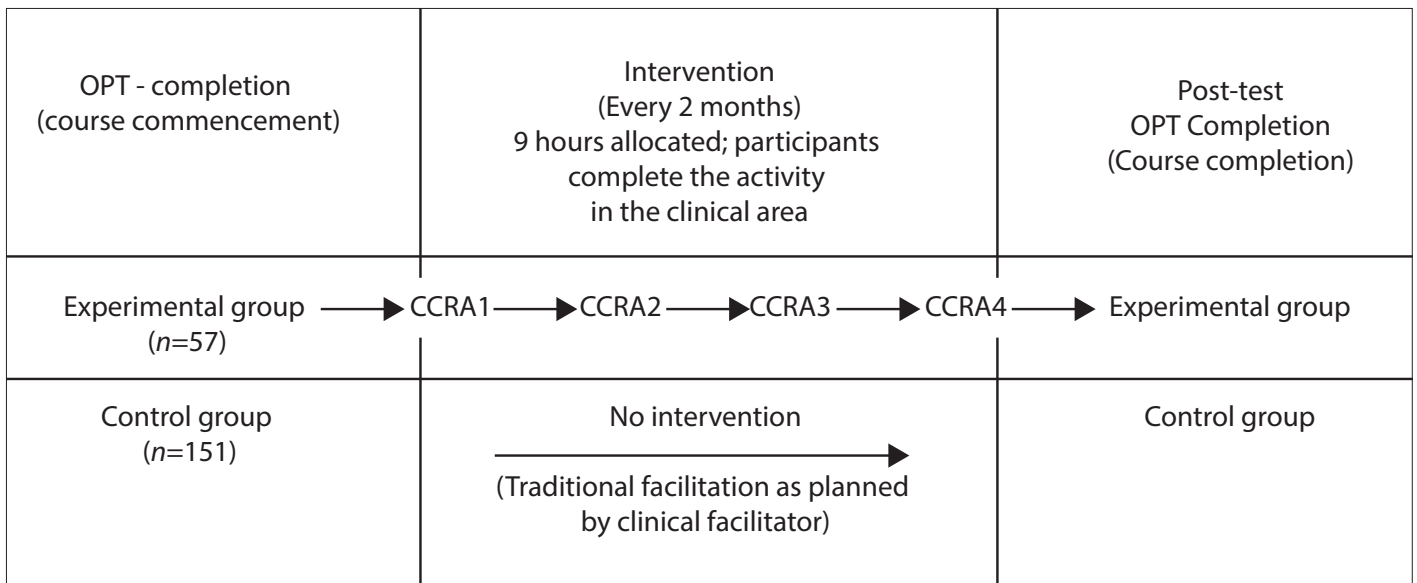


Fig. 1. Data collection process. OPT = outcome-present-state; CCRA = Cooperative Clinical Reasoning Activity.

their group. The groups consisted of 2 - 4 participants, depending on how many students were allocated to a specific hospital.

For the post-test, 200 OPT worksheets were sent out to all participants (experimental and control groups) to complete before the participant wrote their final exams. A few students (n=8) terminated their studies and could therefore no longer participate in the study. A total of 152 participants completed the OPT worksheet individually to determine their developed clinical reasoning skills. The 152 completed OPT worksheets were returned to the researcher for assessment and analysis; however, only 138 could be analysed owing to missing information in the OPT worksheets.

Data analysis

The data were analysed using Microsoft Excel (Microsoft Corp., USA). Descriptive statistics including mean, median and standard deviation (SD), were used to summarise the participants' clinical reasoning skills. In addition, a paired t-test and an independent t-test were performed using an online t-test calculator (OMNICALculator, Poland).

Only results obtained from participants who completed both the pre-test and the post-test (n=106) were included in the analysis. This subset consisted of 60 participants from the control group and 46 participants from the experimental group.

Results

Demographic characteristics

The demographic data collected from participants included age, years of nursing experience and sex (Table 2).

The age group with the largest number of participants was 31 - 35 years (n=35, 33%). The age distribution over the control and experimental groups was similar and equally distributed (Table 2). Most participants (80%) had less than 10 years of nursing experience. Both control and experimental groups mainly consisted of an older population with little nursing experience (Table 2). There were more female (91.5%) than male (5.6%) participants.

Clinical reasoning development

To determine whether the CCRA had a significant impact on the development of clinical reasoning, an independent t-test value was

calculated to compare the pre- and post-test scores between the experimental and control groups (Table 3). The results showed no significant difference between the groups in terms of pre-test scores (p=0.51), suggesting similar clinical reasoning abilities initially. However, post-test analysis showed a significant difference (p=0.007), indicating that the CCRA had a notable impact on the clinical reasoning development of participants in the experimental group.

To delve deeper into the potential influence of participant demographics on their clinical reasoning development, a two-tailed paired t-test was employed. Table 4 presents the outcomes of this analysis.

The Kolmogorov-Smirnov test was employed to assess the distribution of data in the experimental and control groups, confirming equivalence between the groups. In the control group, the pre-test yielded a k-value of 0.45 and a p-value of 0.98 (skewness 0.25), while the post-test yielded a

Table 2. Demographic distribution of participants (N=106)

	Control group (n=60), n (%)	Experimental group (n=46), n (%)	Total (N=106), n (%)
Age distribution			
20 - 24	3 (5)	3 (6.5)	24 (52.1)
25 - 30	13 (21.6)	11 (23.9)	15 (32.6)
31 - 35	19 (31.6)	16 (34.7)	4 (8.6)
36 - 40	11 (18.3)	10 (21.7)	2 (4.3)
40+	12 (20)	6 (13)	1 (2.1)
Not indicated	2 (3.3)	0	
Years of experience			
<5	25 (41.6)	24 (52.1)	49 (46)
5 - 10	21 (35)	15 (32.6)	36 (33.9)
11 - 15	7 (11.6)	4 (8.6)	11 (10.3)
15+	4 (6.6)	2 (4.3)	6 (5.6)
Not indicated	3 (5)	1 (2.1)	4 (3.7)
Sex			
Male	3 (5)	3 (6.5)	6 (5.6)
Female	54 (90)	43 (93.4)	97 (91.5)
Not indicated	3 (5)	0	3 (2.8)

k-value of 0.79 and a *p*-value of 0.53 (skewness 0.21). In the experimental group, the pre-test yielded a k-value of 0.63 and a *p*-value of 0.80 (0.795) (skewness 0.50) and the post-test yielded a k-value of 0.63 and a *p*-value of 0.80 (0.792) (skewness 0.02).

Analyses presented in Table 4 show that both the experimental and control groups exhibited improved clinical reasoning scores across all age groups, years of experience, and sex categories. The most notable improvements were observed in the control group for the 25 - 30 age category (*p*=0.04) and in the experimental group for the 31 - 35 age category (*p*=0.0002). Significant improvements in clinical reasoning skills were also noted in the 36 - 40 age category for both the control (*p*=0.005) and experimental (*p*=0.002) groups.

Regarding years of experience, the most significant improvement was seen in the 5 - 10 years category for the experimental group (*p*=0.0001), while significant gains were also noted in the control group (*p*=0.04) and experimental group (*p*=0.0014). Furthermore, significant improvements were evident in the female category for both the control (*p*=0.002) and experimental (*p*=0.0001) groups.

Discussion

The study aimed to determine whether a developed and validated CCRA could improve the clinical reasoning skills of nursing students. The findings indicate that students exposed to the CCRA demonstrated improved clinical reasoning scores, though the extent of improvement varied among individuals. Given the diverse demographic makeup of the study population, factors such as age, sex and years of nursing experience, were deemed significant, as students enrolled in the bridging course represent a wide range of backgrounds.

Table 3. Independent *t*-test comparing clinical reasoning development between the experimental and control groups

	Control	Experimental	<i>t</i> -value (DF)	<i>p</i> -value
Mean scores				
Pre-test	29.67	28.28	0.67 (104)	0.51
Post-test	34.9	40.33	2.75 (104)	0.007

Clinical reasoning and age

In the present study population, participants ranged in age from 20 years to over 40 years, most possibly owing to the specific nursing course they were enrolled in. All participants were Enrolled nurses completing a Bridging course to qualify as registered nurses. This course caters to already qualified nurses seeking a higher qualification in nursing.

The study findings revealed that age did not predict nor influence the development of clinical reasoning skills. However, participants aged 36 - 40 in both the experimental and control groups demonstrated significant improvements in clinical reasoning ability.^[16] In addition, participants in the 31 - 35 category in the experimental group demonstrated the most noteworthy improvement (*p*=0.0002). This is contrary to suggestions by Carvalho^[17] that younger students could be more susceptible to developing clinical reasoning skills when exposed to targeted activities. Similarly, they challenge the assertion by Clark *et al.*^[18] that age is often associated with cognitive decline, thus older students could be challenged in developing new skills.

Clinical reasoning and nursing experience

The study population encompassed a wide range of years of nursing experience, from participants with as few as 5 years to those with more than 15 years of experience. Participants with less than 5 years of experience showed significant improvement in clinical reasoning scores in both the experimental (*p*=0.0014) and control (*p*=0.04) groups. Additionally, within the experimental group, the 5 - 10 years experience category displayed the most substantial improvement in clinical reasoning ability (*p*=0.0001).

Cappelletti *et al.*^[19] indicated that the experience of a nurse plays a significant role in their ability to reason. In contrast, Lambie *et al.*^[20] showed that even among experienced nurses, clinical reasoning skills can vary, as seen with the experimental group's results. It is apparent that it is not the number of years of nursing experience that influence clinical reasoning, but rather the type of experience a nurse has in any given situation.

Clinical reasoning and sex

There were more female than male participants; nevertheless, the female participants in the experimental group (*p*=0.0001) demonstrated the most significant improvement in their clinical reasoning development.

Table 4. Two-tailed paired *t*-test comparing clinical reasoning skills development across different demographic groups

	Control group (<i>n</i> =60)				Experimental group (<i>n</i> =46)			
	Pre-test mean score	Post-test mean score	<i>t</i> -value (d.f.)	<i>p</i> -value	Pre-test mean score	Post-test mean score	<i>t</i> -value (d.f.)	<i>p</i> -value
Age group, years								
20 - 24	19	24.5	0.65 (1)	0.63	33	41.5	1.13 (1)	0.46
25 - 30	32.63	39.44	2.28 (15)	0.04	31.5	40.8	2.01 (9)	0.08
31 - 35	31.67	31.56	0.063 (17)	0.95	27.69	42.06	5.00 (15)	0.0002
36 - 40	24.64	35.55	3.63 (10)	0.005	24.73	36.64	4.10 (10)	0.002
40+	29.15	35	1.279 (12)	0.23	27.2	40.2	1.85 (4)	0.14
Years of experience								
<5	26.79	31.86	2.199 (27)	0.04	29.61	39.78	3.66 (22)	0.0014
5 - 10	29.86	35.05	2.01 (20)	0.06	25.53	41.47	7.76 (14)	0.0001
10 - 15	35.86	40.14	1.30 (6)	0.24	25.25	32	1.26 (3)	0.3
>15	38	46.25	0.86 (3)	0.46	33.5	51.5	1.13 (1)	0.46
Sex								
Male	32.67	36	1.05 (2)	0.405	28.33	32	0.73 (2)	0.54
Female	29.51	34.84	3.29 (56)	0.002	27.98	40.78	6.84 (40)	0.0001

In another study, Jael^[21] stated that sex did not play a big role in the development of clinical reasoning. However, Yang^[22] determined that female students benefit more than male students when engaged cooperatively. As the CCRA is a cooperative activity, this could have aided the female students in developing their clinical reasoning skills more than the male participants.

Limitations

In March 2020, a National State of Emergency was announced by the President of SA in response to the global COVID-19 pandemic. The mandated lockdown period and the subsequent strain on the health system owing to pandemic-related hospital admissions resulted in some of the experimental groups not getting the opportunity to complete their fourth and final CCRA.

The exclusion of some participants who could not form part of the experimental group owing to the lack of a facilitator or because they were not enough to form a small group, could have impacted the findings.

Additional factors, such as problem-solving abilities, stress, anxiety and academic self-efficacy, were not accounted for but could have influenced the development of clinical reasoning.^[15] This suggests that there might be other variables affecting the enhancement of nursing students' clinical reasoning skills.

Conclusion

The results indicate that the CCRA is a valuable tool for developing clinical reasoning skills in nursing students. Incorporating the CCRA or similar evidence-based programmes into nursing education is strongly recommended. However, it is recommended that the CCRA be implemented and tested in various nursing contexts, not only in undergraduate programmes to confirm its usefulness.

Declaration. None.

Acknowledgements. None.

Author contributions. AN conducted the experiment, interpreted the data and drafted the article. LR performed data analysis, contributed to the final article and supervised the study. Both authors participated in the conceptualisation of the study design and approved the final version of the article and the article reviews.

Funding. None.

Data availability statement. The datasets generated and analysed during the current study will be made available upon reasonable request.

Conflicts of interest. None.

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Submitted 21 October 2023. Accepted 13 September 2024.