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Gizem Açıkgöz, Zuhal Bahar, Cennet Çiriş Yıldız, Burcu Özkan, Meryem Erceylan & Güzin Ünlü Suvari

The Role of Cognitive Approaches in Nursing Students' Learning Experiences: A Quasi-Experimental Study

Cognitive Learning Approaches in Nursing

Gizem Açıkgöz, MSc, PhD[1], Zuhal Bahar, MSc, PhD[2], Güzin Ünlü Suvari, MSc[3], Cennet Çiriş Yıldız, MSc, PhD[2], Burcu Özkan, MSc, PhD[4], Meryem Erceylan, MSc, PhD[5]

[1]Department of Nursing, Faculty of Health Sciences, Istanbul Kent University, Istanbul, Turkey (*Current affiliation: Department of Nursing, Faculty of Health Sciences, Istanbul Atlas University, İstanbul, Turkey)*

[2]Department of Nursing, Faculty of Health Sciences, Istanbul Aydın University, Istanbul, Turkey

[3]Department of Nursing, Faculty of Health Sciences, Acıbadem University, Istanbul, Turkey

[4]Department of Operating Room Services, Vocational School of Health Services, Fenerbahçe University, Istanbul, Turkey

[5]Department of Nursing, Faculty of Health Science, İstinye University, Istanbul, Turkey

Corresponding Author

Gizem Açıkgöz, MSc, PhD
Department of Nursing, Faculty of Health Sciences, Istanbul Kent University, Istanbul, Turkey
Current affiliation: Department of Nursing, Faculty of Health Sciences, Istanbul Atlas University, Istanbul, Turkey
Cendere Street No:24, 34406 Kagithane/Istanbul, Turkey
Email: gzmacikgoz@gmail.com

Phone: +90 506 688 41 09

ABSTRACT

Background: Cognitive learning approaches are important in nursing education because they support analytical thinking, decision-making, and self-regulated learning processes. Competencies such as problem solving, critical thinking, peer support, self-directed learning readiness, and locus of control may contribute to nursing students' academic and professional development. Unlike interventions focusing on a single student-centered teaching strategy or isolated competency, this study examined an integrated cognitive learning program that brought together five learning-related domains through structured conceptual explanation, guided questioning, and group discussion. This study aimed to examine changes in selected learning-related competencies following this integrated cognitive learning intervention among first-year nursing students.

Methods: This non-randomized quasi-experimental pre-test/post-test study with experimental and control groups was conducted at two foundation universities in Istanbul, Türkiye. Group allocation was conducted at the institutional level, with one university assigned to the experimental group and the other to the control group. A total of 114 first-year nursing students completed the study, including 69 in the experimental group and 45 in the control group. The intervention consisted of a structured five-week online educational program comprising five separate 120-minute sessions, with one

session delivered each week and each session focusing on a different cognitive learning domain. Data were collected using validated instruments assessing problem solving, critical thinking, peer support, self-directed learning readiness, and locus of control. Statistical analyses included descriptive statistics, within-group and between-group comparisons, and ANCOVA adjusted for baseline scores.

Results: The intervention was associated with changes in several learning-related outcomes. In the experimental group, self-directed learning readiness increased and showed the clearest adjusted between-group difference. Critical thinking showed a less marked decline than that observed in the control group, although the adjusted between-group difference was not statistically significant. Problem-Solving Inventory scores also changed over time, but these findings require cautious interpretation in view of the scoring characteristics of the instrument. Peer support decreased in the experimental group, and no significant adjusted between-group difference was observed for this outcome. Findings related to locus of control were also mixed and were not supported after adjustment for baseline differences between groups.

Conclusions: The clearest finding was observed for self-directed learning readiness, suggesting that short-term cognitively oriented educational input may be particularly relevant to students' readiness for autonomous learning. Findings for problem solving, critical thinking, peer support, and locus of

control were more mixed, indicating that learning-related outcomes may respond differently to condensed online interventions. By examining multiple domains within a single structured framework, this study contributes preliminary evidence on the domain-specific nature of cognitive learning interventions in nursing education.

Trial registration: Not applicable.

Keywords: cognitive learning; critical thinking; locus of control; nursing education; peer support; problem solving; self-directed learning

BACKGROUND

Nursing education has increasingly shifted from traditional knowledge transmission toward learner-centered approaches that emphasize active participation, reflection, and cognitive engagement. This shift is especially important in nursing, where students are expected not only to acquire theoretical knowledge but also to apply it in complex clinical situations requiring judgment, adaptability, and informed decision-making. Recent evidence suggests that student-centered strategies such as case-based, problem-based, and team-based learning can strengthen important competencies in nursing students, including problem solving, self-directed learning, and communication skills [1,2].

Problem solving is a core competency in nursing education because it supports students' ability to assess situations, interpret information, and develop appropriate responses in clinical practice. Educational approaches

that actively involve students in analysis, inquiry, and decision-making have been shown to enhance problem-solving ability and improve readiness for practice [3]. In addition, broader evidence indicates that active and cognitively engaging teaching methods can meaningfully contribute to nursing students' problem-solving development by moving learning beyond passive reception toward structured application and reasoning [2,4,5]. These findings support the inclusion of problem solving as a key component of integrated educational interventions designed to strengthen multiple learning-related competencies in nursing students [3].

Critical thinking is another essential outcome in nursing education. It involves questioning assumptions, analyzing information, evaluating alternatives, and making reasoned judgments before acting. In nursing practice, critical thinking is closely linked to safe care, sound clinical judgment, and effective professional communication. Recent studies indicate that reflective, structured, and experiential educational strategies may contribute to the development or preservation of critical thinking dispositions, although the magnitude of change may vary according to the intensity and duration of the intervention [6,7]. Critical thinking is also increasingly recognized as relevant not only to academic performance but also to broader professional and psychological outcomes in health-related education [8-10]. This is particularly relevant in the context of integrated educational interventions, as structured and repeated learning experiences

may help support critical thinking alongside other learning-related competencies in nursing students [7,9]

Peer support also plays an important role in students' academic and professional development. Supportive peer relationships can reduce stress, enhance confidence, strengthen belonging, and facilitate collaborative learning in both classroom and clinical settings [11,12]. At the same time, peer support appears to be a relationally complex outcome that may not emerge automatically, especially in digital or weakly structured environments. Studies in nursing education suggest that mentoring, sustained interaction, and clearly organized peer engagement are often needed to support meaningful peer connection and collaboration [13-16]. Accordingly, peer support represents an important but context-sensitive component of integrated educational interventions, particularly when such interventions aim to influence both individual and relational aspects of student learning [12,17].

Self-directed learning has become increasingly important in contemporary nursing education, particularly in flexible and technology-supported learning environments. It refers to students' ability to identify their learning needs, take initiative, plan learning activities, monitor progress, and evaluate outcomes. This competency is closely associated with lifelong learning, adaptability, and professional development in rapidly changing healthcare systems [17]. A growing body of research shows that flipped, blended, team-based, and other student-centered teaching approaches can improve nursing

students' self-directed learning by strengthening self-management, motivation, and active participation in learning tasks [2,18-20]. This is especially relevant for integrated educational interventions, as even relatively short-term structured approaches may help support self-directed learning when they actively engage students in the learning process [19].

Locus of control is another factor that may influence learning outcomes and professional development. Students with a stronger internal locus of control are more likely to perceive success as related to their own effort and decisions, whereas students with a more external orientation may attribute outcomes to luck, chance, or outside forces. In nursing education, internal locus of control has been associated with more adaptive outcomes such as active coping, stronger self-confidence in clinical decision-making, and more positive professional attitudes [21,22]. It has also been linked with broader developmental and academic outcomes, including career maturity and achievement-related functioning, suggesting that perceived control may shape not only how students learn but also how they position themselves within their future profession [23,24]. Accordingly, locus of control may be a relevant component of integrated educational interventions that aim to support not only students' learning behaviors but also their sense of agency and professional development [23].

Taken together, these competencies suggest that nursing students' learning experiences are shaped by both individual cognitive processes and the social-contextual conditions in which learning occurs. Problem solving and critical

thinking represent core cognitive processes related to reasoning, judgment, and decision-making; self-directed learning readiness reflects students' capacity to regulate and take responsibility for their own learning; locus of control reflects beliefs about agency and control over learning-related outcomes; and peer support represents the relational and collaborative dimension of learning in nursing education. However, the effects of cognitively oriented and student-centered interventions may vary across domains and over time. Some short-term interventions have shown limited between-group differences in critical thinking, while follow-up findings suggest that certain outcomes may be maintained whereas more relational or cooperative outcomes may decline over time [6,25]. In addition, online and digital learning environments may present challenges for collaboration, feedback, belonging, and sustained peer interaction unless relational components are deliberately structured [15,16]. Therefore, although these five outcomes provide a multidimensional framework for examining learning-related competencies in nursing students, they were approached as related but potentially differentially responsive domains within a condensed online intervention format.

Therefore, this study aimed to examine changes in problem-solving skills, critical thinking, peer support, self-directed learning readiness, and locus of control following a quasi-experimental educational intervention designed to strengthen nursing students' cognitive approaches to learning. Given the limited evidence on examining these five domains together within a

condensed online intervention format, total scale scores for the five outcomes were treated as the main analyses, whereas subdimension-level findings were considered secondary and exploratory. In interpreting the findings, outcomes more directly linked to cognitive awareness and learning responsibility, such as self-directed learning readiness, were expected to be more responsive to the intervention, whereas more relational or dispositional outcomes, such as peer support and locus of control, were considered more tentative because they may require sustained interaction, experiential learning, or longer-term reinforcement.

DESIGN

Study Design

This study used a quasi-experimental pre-test/post-test design with experimental and control groups.

Participants and Settings

The study was conducted in the departments of nursing within the faculties of health sciences at two foundation universities in Istanbul, Türkiye. One university was assigned to the experimental group and the other to the control group. A quasi-experimental design with institutional allocation was adopted because the intervention was implemented at the program/university level as part of the educational organization of the participating nursing departments; therefore, participant-level randomization was not feasible. The two universities were selected on the basis of their comparable academic

structures and student profiles. The control university was purposively selected because it was considered comparable to the experimental university in terms of institutional type, nursing program structure, and general educational organization. However, this allocation strategy may have increased the risk of selection bias, baseline imbalance, and residual institutional-level confounding, and these issues were considered when interpreting the findings. Because the intervention was assigned at the university level but outcomes were analyzed at the individual-student level, institutional-level confounding and clustering effects could not be fully separated from the intervention effect. Given that only two universities participated, multilevel modeling was not feasible. The study was prospectively planned as a longitudinal educational intervention for the cohort enrolled in the 2020–2021 academic year, with the intention of implementing the intervention on four occasions during the 2021–2024 study period. However, due to major disruptions affecting educational continuity, including the COVID-19 pandemic and the 2023 Southeastern Anatolia earthquake, the intervention could not be implemented as originally planned. Instead, the study was carried out as a single five-week intervention delivered between 22 April 2024 and 20 May 2024, with pre-test assessments administered before the intervention and post-test assessments administered one week after its completion. A census approach was adopted, and all eligible first-year nursing students enrolled in the participating departments were invited to participate. The initial study population consisted of 130

students, including 70 in the experimental group and 60 in the control group. No formal a priori sample size calculation was performed because a census approach was adopted and all eligible first-year nursing students in the participating departments were invited to participate. In accordance with the predefined exclusion criteria, 16 students were excluded from the final analysis. Of these excluded participants, one withdrew for health-related reasons, five transferred to other universities, seven did not complete the post-test assessments, and three could not be reached during follow-up procedures. No formal comparison between retained and excluded participants was performed because of the small number of excluded cases. As a result, the study was completed with 69 students in the experimental group and 45 students in the control group.

Inclusion and Exclusion Criteria

The inclusion criteria were as follows: being a student who had enrolled in the first year of the nursing department at one of the participating foundation universities in Istanbul during the 2020–2021 academic year, voluntary agreement to participate in the study, and willingness to attend the intervention and complete all study procedures.

The exclusion criteria were withdrawal from the university during the study period, absence exceeding 20% of the intervention, and incomplete completion of the pre-test or post-test assessments.

Research Variables

The dependent variables were students' mean scores on problem-solving skills, critical thinking disposition, perceived peer support, self-directed learning readiness, and locus of control. The independent variable was the cognitive learning intervention administered to the experimental group.

Research Hypotheses

H1: The cognitive learning-based educational program will be associated with changes in nursing students' problem-solving skills.

H2: The cognitive learning-based educational program will be associated with changes in nursing students' critical thinking disposition.

H3: The cognitive learning-based educational program will be associated with changes in nursing students' peer support.

H4: The cognitive learning-based educational program will be associated with changes in nursing students' self-directed learning readiness.

H5: The cognitive learning-based educational program will be associated with changes in nursing students' locus of control.

Data Collection Tools

Data were collected using the Descriptive Characteristics Form, the Problem-Solving Inventory, the Marmara Critical Thinking Disposition Scale, the Peer Support Scale, the Self-Directed Learning Readiness Scale, and the Locus of Control Scale.

Descriptive Characteristics Form: The Descriptive Characteristics Form was developed by the researchers based on the relevant literature and consisted of eight questions addressing the participants' sociodemographic and educational characteristics.

Problem-Solving Inventory: Problem-solving skills were assessed using the Problem-Solving Inventory developed by Heppner and Petersen and adapted into Turkish by Şahin, Şahin, and Heppner. The scale is a 6-point Likert-type instrument consisting of 35 items and four subdimensions: impulsive approach, avoidant approach, evaluative approach, and planned approach. In the Turkish adaptation, items 1, 2, 3, 4, 11, 13, 14, 15, 17, 21, 25, 26, 30, and 34 are reverse scored, whereas items 9, 22, and 29 are excluded from scoring. Total scores range from 32 to 192, with lower scores indicating better perceived problem-solving ability. The reported Cronbach's alpha coefficient was 0.90 for the total scale and ranged from 0.72 to 0.85 for the subdimensions [26]. In the present study, the Cronbach's alpha coefficient for the total scale was 0.823.

Marmara Critical Thinking Disposition Scale: Critical thinking disposition was assessed using the Marmara Critical Thinking Disposition Scale developed by Özgenel and Çetin. This 5-point Likert-type scale consists of 28 items and six subdimensions: reasoning, judgment, evidence seeking, truth seeking, open-mindedness, and systematicity. Subdimension scores and the total score are calculated based on mean values, and the scale contains no reverse-coded items. Higher scores indicate a higher disposition toward

critical thinking. The reported Cronbach's alpha coefficient was 0.91 for the total scale and ranged from 0.65 to 0.85 for the subdimensions [27]. In the present study, the Cronbach's alpha coefficient for the total scale was 0.982.

Peer Support Scale: Perceived peer support was measured using the Peer Support Scale, which was adapted into Turkish by Çalışkan and Çınar. The scale is a 4-point Likert-type instrument consisting of 17 items and three subdimensions: physical help, academic help, and emotional help. Total scores range from 17 to 68, with higher scores indicating greater perceived peer support and lower scores indicating lower perceived peer support. The reported Cronbach's alpha coefficient was 0.93 for the total scale and ranged from 0.77 to 0.89 for the subdimensions [28]. In the present study, the Cronbach's alpha coefficient for the total scale was 0.976.

Self-Directed Learning Readiness Scale: Self-directed learning readiness was assessed using the Self-Directed Learning Readiness Scale developed by Fisher and adapted into Turkish by Kocaman, Dicle, Üstün, and Çimen. The scale is a 5-point Likert-type instrument consisting of 40 items and three subdimensions: self-management, desire for learning, and self-control. Total scores range from 40 to 200, with higher scores indicating greater self-directed learning readiness. A total score of 150 or above is considered to indicate a high level of self-directed learning readiness. The reported Cronbach's alpha coefficient was 0.92 for the total scale and ranged from 0.83 to 0.85 for the subdimensions [29]. In the present study, the Cronbach's alpha coefficient for the total scale was 0.987.

Locus of Control Scale: Locus of control was assessed using the Locus of Control Scale originally developed by Rotter and adapted into Turkish by Dağ. The scale is a 5-point Likert-type instrument consisting of 47 items and five subdimensions: personal control, belief in luck, meaninglessness of effort, fatalism, and belief in an unfair world. Higher scores indicate a stronger external locus of control orientation, whereas lower scores indicate a stronger internal locus of control orientation. The reported Cronbach's alpha coefficient for the total scale was 0.92 [30]. In the present study, the Cronbach's alpha coefficient for the total scale was 0.843.

Data Collection and Procedure

All students in the experimental and control groups were informed about the study by the researchers before data collection, and written informed consent was obtained from all participants. Pre-test assessments were administered online via Google Forms to both groups before the intervention. Following the pre-test, the experimental group received the cognitive learning intervention, while the control group continued with the standard nursing curriculum and received no additional educational intervention during the study period. One week after completion of the intervention, post-test assessments were administered online via Google Forms to both groups.

Blinding

Blinding was not feasible due to the nature of the educational intervention. Participants and the researchers delivering the intervention were aware of

study group assignment. Outcome data were collected through self-report measures completed online by the participants.

Intervention

The intervention was originally planned as a longitudinal educational program comprising separate sessions on each cognitive topic throughout the undergraduate nursing curriculum. However, due to major disruptions affecting educational continuity, including the COVID-19 pandemic and the 2023 Southeastern Anatolia earthquake, the implementation process was modified. As a result, the intervention was delivered as a structured online educational program over five weeks, with one 120-minute session delivered each week via Microsoft Teams between 22 April 2024 and 20 May 2024. In total, the intervention comprised five separate sessions, each addressing a different core cognitive learning domain examined in the study: problem solving, critical thinking, peer support, self-directed learning, and locus of control. The sessions were delivered to the experimental group as whole-group online classes via Microsoft Teams. Each session lasted 120 minutes and focused on one of the core cognitive learning domains addressed in the study: problem solving, critical thinking, peer support, self-directed learning, and locus of control. Each session was delivered by a researcher with expertise in the relevant topic area and was conducted using didactic presentation, structured conceptual explanation, interactive question-and-answer, and group discussion. To support intervention fidelity and consistency, the sessions were delivered according to a predefined structured

content plan prepared by the research team, and all sessions followed the same planned sequence, duration, and instructional format. Details of the intervention structure and content are presented in Table 1.

At the beginning of the program, students were informed that the overall purpose of the intervention was to support their learning processes and enhance the quality of their learning experiences by increasing awareness of key cognitive and learning-related domains. Each session followed a similar instructional structure to support consistency across the five-week program. Sessions began with an introduction to the relevant domain, followed by structured conceptual presentation, facilitator-guided explanation, interactive question-and-answer, and whole-group discussion. The sessions were sequenced to introduce each learning-related domain separately while maintaining a common pedagogical logic across the program: conceptual understanding, guided reflection, discussion of relevance to nursing education, and consolidation through questions and group interaction. The predefined session content presented in Table 1 was used to guide delivery and support consistency across sessions. The intervention was intended to influence outcomes by increasing students' conceptual awareness of problem-solving approaches, critical thinking processes, peer support, self-directed learning, and locus of control. Specifically, the problem-solving session aimed to increase awareness of problem identification and decision-making approaches; the critical thinking session focused on questioning, reasoning, and evaluation; the peer support session addressed the meaning

and importance of supportive peer relationships; the self-directed learning session emphasized self-management, motivation, and responsibility for learning; and the locus of control session encouraged reflection on control beliefs and personal responsibility in learning. However, the intervention did not include practice-based components such as simulation, structured peer tasks, or individualized coaching.

Data Analysis

The data were analyzed to assess both within-group and between-group differences in the experimental and control groups. Descriptive statistics were expressed as means, standard deviations, and percentages. Prior to inferential analyses, the distributional properties of the variables were assessed. Parametric tests were applied when the assumptions of normality were considered appropriate, whereas non-parametric alternatives were used when these assumptions were not met. Within-group differences between pre-test and post-test measurements were evaluated using the Paired Samples t-test. Between-group comparisons of the experimental and control groups at both pre-test and post-test were conducted using the Independent Samples t-test or Mann–Whitney U test, as appropriate. Categorical variables were compared using Pearson's chi-square test. In addition, analysis of covariance (ANCOVA) was performed for the main outcome variables, using baseline scores as covariates, to account for pre-existing differences between groups. However, this adjustment was limited to baseline outcome scores and could not fully account for demographic,

educational, or institutional differences between groups. Effect sizes were also calculated to support interpretation of the practical significance of the findings, including Cohen's d for within-group pre–post comparisons and partial eta squared for the adjusted main outcome analyses. Analyses of total scale scores were treated as the main outcome analyses, whereas subdimension analyses were considered secondary and exploratory. No formal correction for multiple comparisons was applied; therefore, subdimension findings were not used as the primary basis for interpretation and should be interpreted with caution. Statistical significance was set at $p < 0.05$ and all statistical analyses were performed using IBM SPSS Statistics version 28. This study was reported in accordance with the TREND statement for nonrandomized evaluations of behavioral and public health interventions.

Ethical Considerations

Ethical approval for this study was obtained from the İstanbul Kent University Health Sciences Research and Publication Ethics Committee (Decision/Approval No: 58797649-050, Date: 01 July 2021). Institutional permissions were also obtained from the participating university administrations before the study was conducted. The study was conducted in accordance with the principles of the Declaration of Helsinki. The purpose and scope of the study were explained to all students, and they were informed that participation was voluntary, that they could withdraw from the study at any time, and that all data would be kept confidential and used solely for research purposes. Written informed consent was obtained from all

participants prior to data collection. In addition, permission to use the measurement instruments included in the study was obtained from the original authors and/or copyright holders.

Use of AI-assisted tools

ChatGPT and Microsoft Copilot were used only to support language editing and improve the readability of the manuscript. They were not used for study design, data analysis, interpretation, or reference generation. All final content was reviewed and approved by the authors.

Rigor

Methodological rigor was supported by the use of a quasi-experimental pre-test/post-test design with experimental and control groups, which enabled the assessment of both within-group and between-group differences. The comparability of the groups was strengthened by selecting two foundation universities with similar academic structures and student profiles. Standardized data collection instruments with established validity and reliability were used, and all procedures were implemented consistently for both groups. Clearly defined inclusion and exclusion criteria were applied, and statistical analyses were selected according to the distributional characteristics of the data. These measures contributed to the methodological transparency and consistency of the study procedures.

FINDINGS

The flow of participants through the study is presented in Figure 1.

Participant Characteristics

The mean age was 21.45 ± 2.45 years in the experimental group and 20.24 ± 1.46 years in the control group. Female students comprised 65.2% of the experimental group and 88.9% of the control group. The mean order of preference for nursing was lower in the experimental group (5.00 ± 5.06) than in the control group (9.44 ± 3.27). Regarding perceived socioeconomic status, 55.1% of the experimental group and 40.0% of the control group reported income equal to expenses. The characteristics of the participants are presented in Table 2. Significant baseline differences were observed between the experimental and control groups in age, gender, preference order for the nursing program, socioeconomic status, and father's educational status. Therefore, adjusted analyses were conducted to account for these baseline differences. No significant differences were found between groups in type of high school, mother's education, or current residence (Table 2).

Psychometric Scale Findings

In the control group, total problem-solving scores decreased significantly from pre- to post-test (144.42 ± 21.45 vs. 132.24 ± 22.58, p = 0.013), whereas the experimental group showed a significant increase (149.71 ± 20.78 vs. 156.32 ± 9.91, p = 0.018). Although no between-group difference was observed at pre-test (p = 0.192), post-test scores were significantly

higher in the experimental group (156.32 ± 9.91 vs. 132.24 ± 22.58, $p < 0.001$). Exploratory subdimension analyses showed changes in several problem-solving approaches, as presented in Table 3. After adjustment for baseline scores using ANCOVA, the experimental group had significantly higher adjusted post-test Problem-Solving Inventory scores than the control group (adjusted mean = 156.06, 95% CI [152.22, 159.91] vs. adjusted mean = 132.12, 95% CI [127.27, 136.96]; $F(1,111) = 58.89$, $p < .001$, $\eta p^2 = .347$) (Table 4). Because higher scores on this inventory indicate poorer perceived problem-solving ability, this adjusted difference should be interpreted cautiously and does not indicate a clear favorable intervention effect.

In the experimental group, total critical thinking disposition scores did not change significantly (118.46 ± 18.75 vs. 113.54 ± 36.30, $p = 0.316$), whereas the control group showed a significant decrease (118.89 ± 23.71 vs. 100.87 ± 25.51, $p < 0.001$). Although no between-group difference was observed at pre-test ($p = 0.916$), post-test scores were significantly higher in the experimental group (113.54 ± 36.30 vs. 100.87 ± 25.51, $p = 0.044$). Exploratory subdimension analyses showed no significant within-group changes in the experimental group, whereas decreases were observed across all subdimensions in the control group. Post-test exploratory comparisons favored the experimental group in truth seeking, open-mindedness, and systematicity, as presented in Table 3. However, after adjustment for baseline scores using ANCOVA, the adjusted between-group difference in post-test critical thinking disposition was not statistically significant

(adjusted mean = 113.09, 95% CI [105.15, 121.03] vs. adjusted mean = 100.89, 95% CI [91.20, 110.58]; F(1,111) = 3.73, p = .056, ηp^2 = .033) (Table 4).

Total peer support scores decreased significantly in the experimental group (47.04 ± 12.95 vs. 40.78 ± 18.24, p = 0.021), while no significant change was observed in the control group (p = 0.337). Between-group differences were not significant at either pre- or post-test (p = 0.400; p = 0.949). Exploratory subdimension analyses showed declines in physical, academic, and emotional support in the experimental group, whereas no significant subdimension changes were observed in the control group, as presented in Table 3. Consistent with the unadjusted between-group comparison, ANCOVA showed no statistically significant adjusted between-group difference in post-test peer support scores (adjusted mean = 40.93, 95% CI [36.83, 45.03] vs. adjusted mean = 40.77, 95% CI [35.63, 45.92]; F(1,111) = 0.002, p = .961, ηp^2 < .001) (Table 4).

In the control group, total self-directed learning readiness scores did not change significantly (132.71 ± 46.51 vs. 127.69 ± 40.84, p = 0.612). In contrast, the experimental group showed a marked increase (165.80 ± 26.53 vs. 197.33 ± 10.96, p < 0.001), with significantly higher scores than the control group at both pre-test and post-test (p < 0.001). Exploratory subdimension analyses showed improvements in self-directedness, willingness to learn, and self-control in the experimental group, whereas no significant subdimension changes were observed in the control group, as

presented in Table 3. After adjustment for baseline scores using ANCOVA, the experimental group had significantly higher adjusted post-test self-directed learning readiness scores than the control group (adjusted mean = 193.30, 95% CI [186.93, 199.68] vs. adjusted mean = 124.90, 95% CI [116.01, 133.79]; $F(1,111) = 150.21$, $p < .001$, $\eta p^2 = .575$) (Table 4).

In the experimental group, total locus of control scores increased significantly (122.93 ± 18.80 vs. 132.49 ± 24.65, $p = 0.030$), while no significant change was observed in the control group ($p = 0.218$). At pre-test, the control group scored higher ($p = 0.020$), but no between-group difference was found at post-test ($p = 0.573$). Exploratory subdimension analyses showed changes in personal control, fatalism, and belief in an unfair world in the experimental group, whereas no significant subdimension changes were observed in the control group. Some baseline subdimension differences were observed, but these did not persist at post-test, as presented in Table 3. However, after adjustment for baseline scores using ANCOVA, the adjusted between-group difference in post-test locus of control scores was not statistically significant (adjusted mean = 131.09, 95% CI [126.26, 135.93] vs. adjusted mean = 136.66, 95% CI [130.86, 142.46]; $F(1,111) = 2.13$, $p = .147$, $\eta p^2 = .019$) (Table 4).

DISCUSSION

This study examined changes associated with an integrated cognitive learning intervention among nursing students at two foundation universities

in Istanbul. The intervention addressed five domains—problem solving, critical thinking, peer support, self-directed learning, and locus of control—and the findings were evaluated within the limits of a non-randomized quasi-experimental design with institutional-level allocation. Overall, the findings showed a heterogeneous pattern across domains. After adjustment for baseline scores, the clearest favorable finding was observed for self-directed learning readiness, whereas findings for problem solving, critical thinking, peer support, and locus of control were either mixed, not statistically supported after adjustment, or required cautious interpretation due to scale direction. This pattern suggests that cognitively oriented educational input may be differentially associated with learning-related outcomes and may not influence all domains in the same way. For this reason, the discussion primarily focuses on total scale and adjusted findings, whereas subdimension-level results are considered exploratory and are interpreted only as supportive or contextual findings.

Total Problem-Solving Inventory scores increased in the experimental group while decreasing in the control group, and the adjusted between-group difference remained statistically significant. However, because higher scores on this inventory indicate poorer perceived problem-solving ability, the direction of this finding warrants cautious interpretation. Rather than demonstrating a straightforward improvement in problem-solving ability, the findings may suggest that the short-term online intervention was associated with changes in how students perceived, reflected on, or evaluated their own

problem-solving processes. Previous research has shown that student-centered approaches such as case-based, problem-based, and team-based learning can support problem-solving development in nursing education [2]. Likewise, concept mapping, mind mapping, and other design-oriented strategies have been associated with stronger knowledge organization and application in problem-solving contexts [1,5]. Structured and inquiry-based teaching approaches may also contribute by encouraging metacognitive engagement and active reasoning during learning [3]. At the same time, not all innovative educational methods appear to influence problem-solving in the same way, and some interventions have shown limited or inconsistent effects [4]. Recent evidence further indicates that the effects of such approaches may vary according to intervention duration, learner level, and implementation context, with short-term interventions sometimes producing mixed findings and first-year students responding differently from more advanced learners [25,31]. In this respect, the present findings may reflect the complexity of influencing perceived problem-solving processes in a short-term online format among early-stage nursing students.

Total critical thinking disposition scores did not change significantly in the experimental group, whereas a significant decline was observed in the control group. Although the unadjusted post-test comparison favored the experimental group, the adjusted between-group difference was not statistically significant. Therefore, this finding should be interpreted as a possible trend rather than clear evidence of an intervention-related effect.

This pattern may nevertheless be considered in light of the difficulty of producing measurable changes in critical thinking disposition through short-term interventions, particularly among first-year nursing students who are still adapting to university learning and professional expectations [9]. Similar findings have been reported in short-term educational interventions, suggesting that condensed formats may not always produce clear gains in critical thinking-related outcomes [6,25]. In contrast, longer and more structured interventions have been associated with more favorable outcomes, highlighting the possible importance of duration, continuity, and reinforcement in the development of critical thinking [9]. The exploratory subdimension findings also showed a similar pattern. Although no significant changes were observed across the critical thinking subdimensions in the experimental group, the control group showed declines in all subdimensions, and post-test exploratory comparisons were in favor of the experimental group in truth seeking, open-mindedness, and systematicity. These dimensions are relevant to questioning assumptions, considering alternatives, and engaging in organized reasoning in nursing education [8,10]. However, because these subdimension analyses were exploratory and no correction for multiple testing was applied, they should be interpreted cautiously. Taken together, the present findings suggest that critical thinking disposition may be relatively less responsive than self-directed learning readiness to a condensed online intervention format and may require more

sustained, cyclically reinforced educational approaches such as case analysis, reflection, and concept organization [7].

Peer support scores decreased significantly in the experimental group; however, the adjusted between-group difference was not statistically significant. Therefore, this finding should be interpreted cautiously and should not be considered evidence of an intervention-related decrease in peer support. Rather, the observed pattern may reflect the structure and scope of the intervention. Prior studies show that peer-assisted learning can reduce stress and anxiety, strengthen confidence and competence, and support coping in clinical education [11,12,32]. Unlike individually oriented outcomes, however, peer support depends on trust, interaction, and social integration, which often require time and structured engagement to develop. The present intervention did not include direct peer-support practices such as mentoring, peer pairing, collaborative tasks, or sustained relational activities, but instead provided conceptual content in an online whole-group format. This pattern may indicate a mismatch between the relational nature of peer support and the primarily informational, short-term, online structure of the intervention. Evidence from distance nursing education further indicates that reduced collaboration, limited feedback, and weaker belonging can negatively affect peer support [15], while digital peer mentoring is difficult to sustain without clear structure and integration into academic activities [16]. Studies of structured peer-assisted learning likewise show that sustained, purposeful interaction strengthens peer bonding and collaborative

support [33,34]. Accordingly, the pattern observed here may reflect the limited relational depth of a short-term online informational intervention rather than the ineffectiveness of peer-based approaches.

Self-directed learning readiness showed the clearest favorable pattern in the study. Scores increased significantly in the experimental group, and the adjusted ANCOVA results also indicated significantly higher post-test scores in the experimental group after controlling for baseline values. This finding suggests that the intervention may have supported readiness for autonomous learning, even though it was not designed as a direct self-directed learning programme. Evidence shows that student-centered approaches may support self-directed learning by fostering active engagement, inquiry, and collaborative problem-solving [2,18,31]. Short-term and blended educational models have also been associated with gains in self-directed learning through strengthened motivation, self-management, and participation [19,20,25]. Nevertheless, the finding should still be interpreted within the limits of the non-randomized design, baseline group differences, and the short duration of the intervention. The intervention did not include dedicated activities such as learning contracts, self-monitoring, or guided self-assessment. Therefore, the observed increase may be related to greater awareness of learning processes and cognitive responsibility. Prior research indicates that self-directed learning requires structured processes and supportive educational frameworks rather than teaching method changes alone [17]. It has also been linked to self-efficacy, positive academic emotion, metacognitive ability, and

related psychological resources [35,36]. Overall, the findings suggest that the intervention may have had its most meaningful association with readiness for autonomous learning, although further studies are needed to determine whether such gains can be sustained over time.

Locus of control scores increased significantly in the experimental group in the unadjusted analysis. However, this finding should be interpreted cautiously because higher scores on this scale indicate a stronger external locus of control orientation rather than a stronger internal sense of agency. In addition, after adjustment for baseline scores, the between-group difference was not statistically significant, suggesting that the observed unadjusted change may partly reflect baseline differences or other contextual factors rather than a clear intervention-related effect. The intervention also did not include a specific locus-of-control component but rather provided broader theoretical content that may have been associated with students' reflections on control and responsibility [22,24]. Previous research has shown that internal locus of control is associated with more adaptive outcomes such as stronger coping and greater confidence in clinical decision-making [22], as well as career maturity and reduced anxiety [21,24]. By contrast, external control beliefs have been associated with less favorable outcomes, and similar findings in newly graduated nurses have linked external work locus of control to higher stress and transition shock [37]. Accordingly, the present findings should be viewed as exploratory and mixed rather than as evidence of a favorable change in locus of control.

Limitations

The intervention was initially planned as a longitudinal program integrated across the four-year nursing curriculum. However, due to major external disruptions, including the COVID-19 pandemic and the 2023 Southeastern Anatolia earthquake, it was adapted into a structured five-week online program conducted between April and May 2024. This modification may have reduced continuity and long-term reinforcement. Additionally, the non-randomized quasi-experimental design constitutes an important methodological limitation. Because group allocation was performed at the institutional level rather than through individual randomization, selection bias may have occurred, and internal validity may have been reduced. In addition, outcomes were analyzed at the individual-student level even though the intervention was assigned at the university level; therefore, institutional-level confounding and clustering effects could not be fully separated from the intervention effect. Multilevel modeling was not feasible because only two universities participated in the study. Baseline differences between groups, including age, gender, socioeconomic status, father's educational status, and preference order for the nursing program, may also have influenced learning-related outcomes independently of the intervention. Although ANCOVA was used to adjust for baseline outcome scores, this approach could not fully eliminate the potential influence of demographic, educational, or institutional differences between groups. Accordingly, the observed effects cannot be attributed solely to the intervention. In addition, no formal a priori sample

size calculation was performed, which should be considered when interpreting the findings. In addition, although the reasons for exclusion and loss to follow-up were documented, no formal comparison between retained and excluded participants was conducted because of the small number of excluded cases; therefore, attrition-related bias cannot be entirely ruled out. Because the experimental and control groups were drawn from different universities, unmeasured institutional or curricular differences may also have influenced the findings. The use of online self-report measures may also have introduced response-related bias, including the possibility of social desirability. In addition, post-test assessments were conducted one week after completion of the intervention, which limits evaluation of the durability of the observed changes. The absence of longer-term follow-up prevents conclusions regarding the persistence of the findings over time. In addition, the intervention primarily involved structured online instruction and did not include practice-based components such as simulation, teamwork, or structured peer-interaction activities, which may have limited its influence on some outcomes, particularly peer support. The study was limited to first-year nursing students from two foundation universities, which may constrain generalizability. Nonetheless, the findings provide valuable preliminary evidence on the potential contribution of cognitive learning approaches to nursing education outcomes.

CONCLUSIONS

This study suggests that an integrated cognitive learning approach was most clearly associated with improved self-directed learning readiness among nursing students, while findings for problem solving warrant cautious interpretation in view of the scoring characteristics of the instrument used. Although critical thinking scores did not improve significantly, the pattern of findings suggested a less marked decline relative to the control group; however, this result was not supported after adjustment for baseline differences. At the same time, the findings indicate that effects varied across domains, and peer support and locus of control did not show clear adjusted benefits. Overall, these results contribute to nursing education research by showing that short-term cognitively oriented online interventions may be more relevant to some learning-related domains than others, particularly in relation to self-directed learning readiness. These findings should be interpreted within the limits of the non-randomized design, institutional allocation, baseline group differences, and short-term follow-up.

IMPLICATIONS AND RECOMMENDATIONS

The findings of this study suggest that cognitively oriented educational strategies may have potential value in supporting selected learning-related outcomes in nursing education, particularly in individually oriented domains such as self-directed learning readiness. At the same time, the findings related to problem solving should be interpreted cautiously because of the scoring direction of the instrument, and outcomes such as critical thinking, peer support, and locus of control did not show clear adjusted benefits. For

curriculum design, short-term cognitive learning sessions may be used as introductory components to raise students' awareness of learning responsibility, problem-solving approaches, and reflective thinking; however, they should be complemented by more sustained, practice-based, and feedback-rich learning activities. The results indicate that not all domains respond similarly to short-term online input, and outcomes such as peer support may require more sustained and relationally focused educational approaches. Accordingly, broader strategies such as case discussions, guided reflection, peer-supported learning, mentoring, self-monitoring, and feedback-rich activities should be considered as possible directions for future curriculum development and future research rather than as direct implications established by the present study. Future studies should examine longer-term, multi-component interventions in diverse institutional contexts to better understand how cognitive learning approaches can be sustained and how their effects may vary across different learning-related domains. Future research should also evaluate intervention fidelity, longer-term sustainability, mechanism-specific effects, and differential responsiveness across student subgroups.

Abbreviations

No abbreviation was used

Ethics approval and consent to participate

Ethical approval for the study was obtained from the ethics committee of Istanbul Kent University Ethics Committee with approval number 58797649-050 on July 1, 2021, and institutional permission was granted by the university. The purpose and scope of the study were explained to the participants, who were informed that all data collected would be kept confidential and used solely for research purposes. Written informed consent was obtained from all participants prior to completing the questionnaire. In addition, permission to use all measurement scales included in the study was obtained from the original authors and/or copyright holders.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

G.A. contributed to conceptualization, methodology, investigation, resources, data curation, intervention delivery, data collection, and writing the original draft. Z.B. contributed to conceptualization, methodology, formal analysis, intervention delivery, data collection, writing-review and editing, and supervision. G.Ü.S. contributed to conceptualization, methodology, formal analysis, investigation, resources, data curation, intervention delivery, data collection, and writing-review and editing. C.Ç.Y. contributed to conceptualization, methodology, intervention delivery, data collection, and writing-review and editing. B.Ö. contributed to conceptualization, methodology, intervention delivery, data collection, and writing-review and editing. M.E. contributed to conceptualization, methodology, intervention delivery, data collection, and writing-review and editing. All authors read and approved the final manuscript.

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TABLES

Table 1. Scientific Learning Approach Education Program and Content

Table 2. Participant Characteristics

Education Title	Time	Duration	Number of Participants	Content
Problem Solving	22 April 2024	120 min	70	Problem solving, decision making, and related concepts; the importance of problem solving and decision making in nursing; methods and techniques for problem solving and decision making
Critical Thinking	29 April 2024	120 min	70	Critical thinking and related concepts; critical thinking in nursing and its importance; effective methods and techniques for developing critical thinking
Peer Support	6 May 2024	120 min	69	Peer support, its types, and related concepts; peer support in nursing and its importance; the peer support process and its development
Self-Directed Learning	13 May 2024	120 min	69	Self-directed learning and related concepts; self-directed learning in nursing and its importance; the self-directed learning process and strategies
Locus of Control	20 May 2024	120 min	70	Locus of control and related concepts; locus of control in nursing and its importance; types of locus of control and development of locus of control

		Experimental (n=69)		Control (n=45)		Statistics	
		Min-max scores	**Mean ± SD**	**Min-max scores**	**Mean ± SD**	**U**	**p[a]**
Age		19.0-36.0	21.45 ± 2.45	18.00-25.00	20.24 ± 1.46	974.5	**<.001**
Preference Order for Nursing Program		1.0-23.0	5.00 ± 5.06	1.00-14.00	9.44 ± 3.27	25.5	**<.001**
		n	**%**	**n**	**%**	**X^2**	**p[b]**
Gender	**Female**	45	65.2	40	88.9	8.046	**.005**
	Male	24	34.8	5	11.1		
High School Type	**Anatolian HS**	37	53.6	24	53.3	2.927	.403
	Vocational HS	5	7.2	2	4.4		
	Private HS	8	11.6	10	22.2		
	General HS	19	27.5	9	20.0		
Socioeconomic Status	**Income exceeds expenses**	6	8.7	14	31.3	**9.501**	**.009**
	Income equals expenses	38	55.1	18	40.0		
	Expenses exceed income	25	36.2	13	28.9		
Mother's Educational Level	**Primary School**	39	56.5	16	35.6	6.634	.085
	Secondary School	13	18.8	9	20.0		
	High School	11	15.9	10	22.2		
	University	6	8.7	10	22.2		
Father's Educational Status	**Primary School**	24	34.8	8	17.8	11.748	**.003**
	High School	34	49.3	17	37.8		
	University	11	15.9	20	44.4		
Most Frequently Lived Place	**Village**	7	10.1	4	8.9	3.134	.371
	District	10	14.5	4	8.9		
	City	22	31.9	10	22.2		
	Metropolitan City	30	43.5	27	69.0		

SD: Standard deviation, [a]Mann-Whitney U Testi, [b]Pearson chi-square test

Table 3. Scale and sub-dimension scores of the experimental and control groups

	Experimental (n=69)	Control (n=45)	Statistics

	Mean ± SD	Min-max scores	Mean ± SD	Min-max scores	t	p[c]
Problem-Solving Skills Scale (PSSS)						
Impetuous Approach Pre-Test	34.61±8.06	14.00-50.00	31.49±9.93	18.00-48.00	1.842	.068
Impetuous Approach Post Test	32.07±2.82	30.00-38.00	33.96±7.95	21.00-49.00	-1.804	.074
Test Statistic	t=2.246	**p[d]=.028** **d = 0.37**	t= -1.33	p[d]=.190		
Avoidant Approach Pre-Test	19.61±4.69	4.00-24.00	20.09±5.72	6.00-24.00	-489	.626
Avoidant Approach Post-Test	22.78±1.22	21.00-24.00	18.24±4.80	9.00-24.00	7.510	**< .001**
Test Statistic	t=-5.519	**p[d]< .001** **d = 0.87**	t= 1.879	p[d]=.067		
Evaluative Approach Pre-Test	14.59±3.27	3.00-18.00	14.78±4.64	3.00-18.00	-248	.805
Evaluative Approach Post-Test	15.29±2.84	11.00-18.00	12.02±4.09	5.00-18.00	5.038	**< .001**
Test Statistic	t=-1.32	p[d]=.191	t= 3.009	p[d]=.004		
Planned Approach Pre-Test	19.80±3.66	4.00-24.00	17.89±5.64	4.00-24.00	2.191	.031
Planned Approach Post-Test	21.93±1.94	19.00-24.00	15.40±6.18	4.00-24.00	8.199	**< .001**
Test Statistic	t= -4.453	**p[d]< .001** **d = 0.75**	t= 1.963	p[d]=.056		
Total Pre-Test	149.71±20.78	108.00-193.00	144.42±21.45	114.00-179.00	1.311	.192
Total Post-Test	156.32±9.91	139.00-169.00	132.24±22.58	109.00-184.00	7.794	**< .001**
Test Statistic	t= -2.433	**p[d]=.018** **d = 0.35**	t= 2.577	p[d]=.013		
Marmara Critical Thinking Tendency Scale (MCTTS)						
Reasoning Pre-Test	25.46±4.13	11.00-30.00	25.62±5.22	15.00-30.00	-180	.857
Reasoning Post-Test	24.84±8.46	6.00-30.00	22.16±5.43	12.00-30.00	1.889	.062
Test Statistic	t=.537	p[d]=.593	t= 3.324	**p[d]=.002**		
Judgement Pre-Test	25.19±3.68	14.00-30.00	25.31±5.31	17.00-30.00	-146	.884
Judgement Post-Test	24.00±8.31	6.00-30.00	21.49±5.74	12.00-30.00	1.770	.080
Test Statistic	t= 1.042	p[d]=.301	t= 3.411	**p[d]=.001**		
Evidence Seeking Pre-Test	16.84±3.04	7.00-20.00	17.18±3.04	12.00-20.00	-579	.564
Evidence Seeking Post-Test	15.91±4.66	6.00-20.00	14.33±3.93	8.00-20.00	1.878	.063
Test Statistic	t= 1.312	p[d]=.194	t= 3.862	**p[d]< .001**		
Truth Seeking Pre-Test	16.71±3.14	6.00-20.00	17.13±3.60			
Truth Seeking Post-Test	15.74±4.52	6.00-20.00	14.00±4.03	**p[d]< .001**	-668	.506
Test Statistic	t= 1.494	p[d]=.140	t= 4.153		2.092	**.039**
Open Mindedness Pre-Test	17.06±3.04	4.00-20.00	16.58±4.74	11.00-20.00	660	.511
Open Mindedness Post-Test	16.43±5.27	5.00-20.00	14.44±3.24	7.00-20.00	2.267	**.025**
Test Statistic	t=.773	p[d]=.442	t= 2.618	**p[d]=.012**		
Systematicity Pre-Test	17.06±3.11	4.00-20.00	17.07±3.29	12.00-20.00	-13	.990
Systematicity Post-Test	16.61±5.27	5.00-20.00	14.44±3.56	9.00-20.00	2.416	**.017**
Test Statistic	t=.578	p[d]=.566	t= 3.761	**p[d]< .001**		
Total Pre-Test	118.46±18.75	53.00-140.00	118.89±23.71	79.00-140.00	-106	.916
Total Post-Test	113.54±36.30	34.00-140.00	100.87±25.51	61.00-140.00	2.035	**.044**
Test Statistic	t= 1.01	p[d]=.316	t= 3.656	**p[d]< .001**		
Peer-Support Scale (PSS)						
Physical Support Pre-Test	25.03±6.93	9.00-36.00	23.87±9.33	9.00-36.00	762	.448
Physical Support Post-Test	21.97±9.22	9.00-36.00	21.71±8.85	9.00-36.00	149	.881
Test Statistic	t= 2.196	**p[d]=.031** **d = 0.35**	t= 1.112	p[d]=.272		
Academic Support Pre-Test	11.16±3.27	4.00-16.00	10.91±4.31	4.00-16.00	349	.728
Academic Support Post-Test	9.32±4.39	4.00-16.00	9.56±4.03	4.00-16.00	-290	.772
Test Statistic	t= 2.899	**p[d]=.005** **d = 0.45**	t= 1.499	p[d]=.141		

Emotional Support Pre-Test		10.86±3.41	4.00-16.00	9.82±4.52	4.00-16.00	1.389	.168
Emotional Support Post-Test		9.49±4.74	4.00-16.00	9.73±3.77	4.00-16.00	-286	.775
Test Statistic		t= 2.001	**p^d=.049**	t=.098	p^d=.922		
			d = 0.30				
Total Pre-Test		47.04±12.95	17.00-68.00	44.60±17.92	17.00-68.00	845	.400
Total Post-Test		40.78±18.24	17.00-68.00	41.00±16.58	17.00-68.00	-64	.949
Test Statistic		t= 2.355	**p^d=.021**	t=.970	p^d=.337		
			d = 0.40				
Self-Responsiveness to Learning Scale (SRLS)							
Self-Directedness Pre-Test		51.68±8.90	26.00-65.00	43.40±14.81	13.00-64.00	3.730	**< .001**
Self-Directedness Post-Test		64.01±6.14	58.00-91.00	39.87±12.49	22.00-65.00	13.739	**< .001**
Test Statistic		t=-9.217	**p^d< .001**	t=1.132	p^d=.264		
			d = 1.50				
Willingness to Learn Pre-Test		51.09±8.34	15.00-60.00	39.93±13.65	12.00-59.00	5.418	**< .001**
Willingness to Learn Post-Test		58.65±3.30	53.00-69.00	39.22±13.30	16.00-60.00	11.625	**< .001**
Test Statistic		t=-6.907	**p^d< .001**	t=.235	p^d=.815		
			d = 1.20				
Self-Control Pre-Test		63.03±10.87	18.00-75.00	49.38±18.48	15.00-74.00	4.965	**< .001**
Self-Control Post-Test		74.67±5.22	72.00-102.00	48.60±15.70	22.00-75.00	12.778	**< .001**
Test Statistic		t=-8.03	**p^d< .001**	t=.205	p^d=.839		
			d = 1.30				
Total Pre-Test		165.80±26.53	59.00-200.00	132.71±46.51	40.00-190.00	4.831	**< .001**
Total Post-Test		197.33±10.96	183.00-236.00	127.69±40.84	60.00-200.00	13.468	**< .001**
Test Statistic		t=-8.86	**p^d< .001**	t=.511	p^d=.612		
			d = 1.60				
Locus of Control Scale (LOC)							
Personal Control Pre-Test		47.42±12.24	18.00-72.00	51.29±12.79	32.00-72.00	-1.620	.108
Personal Control Pre-Test		53.71±18.94	35.00-90.00	58.09±18.90	28.00-90.00	-1.208	.230
Test Statistic		t=-2.272	**p^d= .026**	t=-1.982	p^d=.054		
			d = 0.40				
Belief in Luck Pre-Test		31.68±5.85	17.00-44.00	32.18±4.47	27.00-42.00	-484	.629
Belief in Luck Post-Test		33.13±7.98	20.00-44.00	31.73±4.55	21.00-37.00	1.066	.289
Test Statistic		t=-1.126	p^d=.264	t=.424	p^d=.674		
Meaninglessness of Effort Pre-Test		23.25±4.88	14.00-33.00	26.58±6.11	19.00-39.00	-3.222	**.002**
Meaninglessness of Effort Post-Test		24.26±10.37	14.00-44.00	24.82±6.40	14.00-38.00	-325	.746
Test Statistic		t=-.644	p^d=.521	t=1.229	p^d=.226		
Fatalism Pre-Test		9.97±2.67	3.00-15.00	8.87±3.04	4.00-14.00	2.043	**.043**
Fatalism Post-Test		8.70±3.49	3.00-13.00	8.29±3.60	3.00-15.00	601	.549
Test Statistic		t=2.728	**p^d=.008**	t=.865	p^d=.392		
			d = 0.35				
Belief in an Unfair World		10.61±3.40	5.00-20.00	12.04±3.46	8.00-20.00	-2.191	**.031**
Belief in an Unfair World		12.70±6.44	5.00-23.00	11.80±4.04	5.00-20.00	832	.407
Test Statistic		t=-2.331	**p^d=.023**	t=.278	p^d=.782		
			d = 0.30				
Total Pre-Test		122.93±18.80	63.00-154.00	130.96±15.80	97.00-150.00	-2.369	**.020**
Total Post-Test		132.49±24.65	83.00-159.00	134.73±12.35	99.00-147.00	-565	.573
Test Statistic		t=-2.219	**p^d=.030**	t=-1.249	p^d=.218		
			d = 0.35				
		n	**%**	**n**	**%**	**X^2**	**p^b**
"High Learning Ability Status" According to Self-Learning Readiness" Pre-Test	**Yes**	61	88.41	19	42.22	27.757	***< .001***
	No	8	11.59	26	57.78		
"High Learning Ability Status" According to Self-	**Yes**	69	100	19	42.22	49.101	***< .001***
	No	0	0	26	57.78		

Learning Readiness" Post-Test	

SD: Standard deviation, [b]Pearson qhi-square test, [c]Independent Samples t test, [d]Paired-Samples t test
Cohen's d values are reported for statistically significant within-group pre–post comparison

Table 4. Adjusted ANCOVA Results for Primary Outcomes

Outcomes	Adjusted Mean (Experimental)	95% CI	Adjusted Mean (Control)	95% CI	F (1,111)	p	ηp²
Problem-Solving Skills	156.06	152.22–159.91	132.12	127.27–136.96	58.89	**<.001**	.347
Critical Thinking	113.09	105.15–121.03	100.89	91.20–110.58	3.73	.056	.033
Peer Support	40.93	36.83–45.03	40.77	35.63–45.92	0.002	.961	<.001
Self-Directed Learning Readiness	193.30	186.93–199.68	124.90	116.01–133.79	150.21	**<.001**	.575
Locus of Control	131.09	126.26–135.93	136.66	130.86–142.46	2.13	.147	.019

ANCOVA = Analysis of Covariance; ηp² = partial eta squared. All analyses were adjusted for baseline (pre-test) scores. Adjusted means are presented as estimated marginal means with 95% confidence intervals. ANCOVA assumption checks were conducted for all primary outcomes.

FIGURES

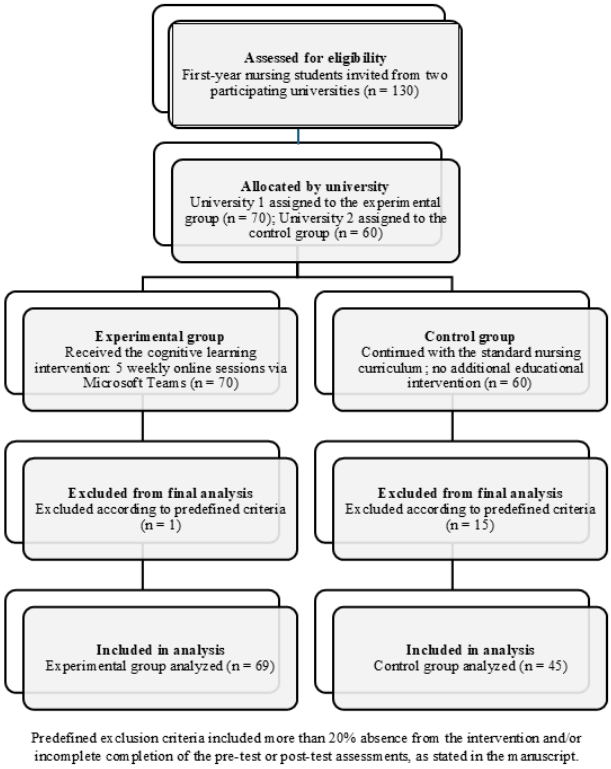

Figure 1. Participant flow diagram of the student

The Role of Cognitive Approaches in Nursing Students' Learning Experiences: A Quasi-Experimental Study

Cognitive Learning Approaches in Nursing

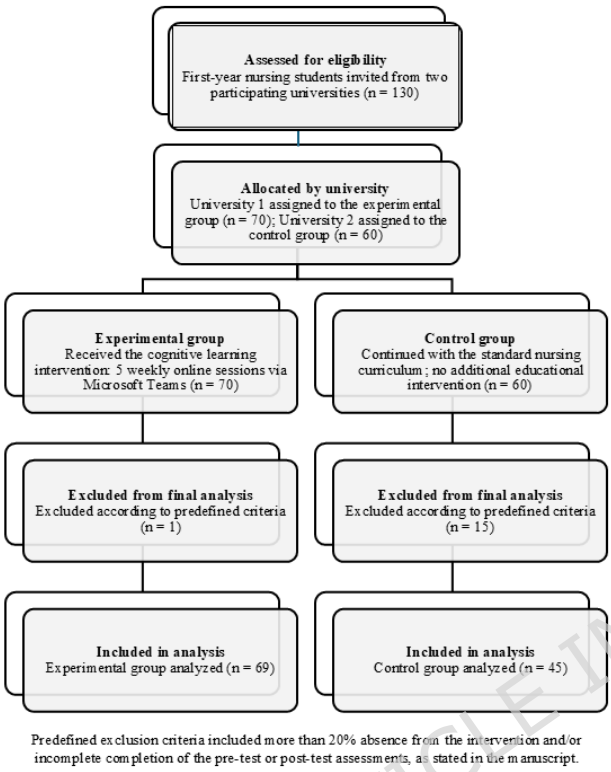

Figure 1. Participant flow diagram of the study

The Role of Cognitive Approaches in Nursing Students' Learning Experiences: A Quasi-Experimental Study

TABLES

Table 1. Scientific Learning Approach Education Program and Content

Education Title	Time	Duration	Number of Participants	Content
Problem Solving	22 April 2024	120 min	70	Problem solving, decision making, and related concepts; the importance of problem solving and decision making in nursing; methods and techniques for problem solving and decision making
Critical Thinking	29 April 2024	120 min	70	Critical thinking and related concepts; critical thinking in nursing and its importance; effective methods and techniques for developing critical thinking
Peer Support	6 May 2024	120 min	69	Peer support, its types, and related concepts; peer support in nursing and its importance; the peer support process and its development
Self-Directed Learning	13 May 2024	120 min	69	Self-directed learning and related concepts; self-directed learning in nursing and its importance; the self-directed learning process and strategies
Locus of Control	20 May 2024	120 min	70	Locus of control and related concepts; locus of control in nursing and its importance; types of locus of control and development of locus of control

Table 2. Participant Characteristics

		Experimental (n=69)		Control (n=45)		Statistics	
		Min-max scores	Mean ± SD	Min-max scores	Mean ± SD	U	p[a]
Age		19.0-36.0	21.45 ± 2.45	18.00-25.00	20.24 ± 1.46	974.5	**<.001**
Preference Order for Nursing Program		1.0-23.0	5.00 ± 5.06	1.00-14.00	9.44 ± 3.27	25.5	**<.001**
		n	**%**	**n**	**%**	**X^2**	**p[b]**
Gender	**Female**	45	65.2	40	88.9	8.046	**.005**
	Male	24	34.8	5	11.1		
High School Type	**Anatolian HS**	37	53.6	24	53.3	2.927	.403
	Vocational HS	5	7.2	2	4.4		
	Private HS	8	11.6	10	22.2		
	General HS	19	27.5	9	20.0		
Socioeconomic Status	**Income exceeds expenses**	6	8.7	14	31.3	**9.501**	**.009**
	Income equals expenses	38	55.1	18	40.0		
	Expenses exceed income	25	36.2	13	28.9		
Mother's Educational Level	**Primary School**	39	56.5	16	35.6	6.634	.085
	Secondary School	13	18.8	9	20.0		
	High School	11	15.9	10	22.2		
	University	6	8.7	10	22.2		
Father's Educational Status	**Primary School**	24	34.8	8	17.8	11.748	**.003**
	High School	34	49.3	17	37.8		
	University	11	15.9	20	44.4		

Most Frequently Lived Place	**Village**	7	10.1	4	8.9	3.134	.371
	District	10	14.5	4	8.9		
	City	22	31.9	10	22.2		
	Metropolitan City	30	43.5	27	69.0		

SD: Standard deviation, [a]Mann Whitney U Testi, [b]Pearson qhi-square test

Table 3. Scale and sub-dimension scores of the experimental and control groups

	Experimental (n=69)		**Control (n=45)**		**Statistics**	
	Mean ± SD	**Min-max scores**	**Mean ± SD**	**Min-max scores**	**t**	**p[c]**
Problem-Solving Skills Scale (PSSS)						
Impetuous Approach Pre-Test	34.61±8.06	14.00-50.00	31.49±9.93	18.00-48.00	1.842	.068
Impetuous Approach Post Test	32.07±2.82	30.00-38.00	33.96±7.95	21.00-49.00	-1.804	.074
Test Statistic	t=2.246	**p[d]=.028**	t= -1.33	p[d]=.190		
		d = 0.37				
Avoidant Approach Pre-Test	19.61±4.69	4.00-24.00	20.09±5.72	6.00-24.00	-489	.626
Avoidant Approach Post-Test	22.78±1.22	21.00-24.00	18.24±4.80	9.00-24.00	7.510	**< .001**
Test Statistic	t=-5.519	**p[d]< .001**	t= 1.879	p[d]=.067		
		d = 0.87				
Evaluative Approach Pre-Test	14.59±3.27	3.00-18.00	14.78±4.64	3.00-18.00	-248	.805
Evaluative Approach Post-Test	15.29±2.84	11.00-18.00	12.02±4.09	5.00-18.00	5.038	**< .001**
Test Statistic	t=-1.32	p[d]=.191	t= 3.009	p[d]=.004		
Planned Approach Pre-Test	19.80±3.66	4.00-24.00	17.89±5.64	4.00-24.00	2.191	.031
Planned Approach Post-Test	21.93±1.94	19.00-24.00	15.40±6.18	4.00-24.00	8.199	**< .001**
Test Statistic	t= -4.453	**p[d]< .001**	t= 1.963	p[d]=.056		
		d = 0.75				
Total Pre-Test	149.71±20.78	108.00-193.00	144.42±21.45	114.00-179.00	1.311	.192
Total Post-Test	156.32±9.91	139.00-169.00	132.24±22.58	109.00-184.00	7.794	**< .001**
Test Statistic	t= -2.433	**p[d]=.018**	t= 2.577	p[d]=.013		
		d = 0.35				
Marmara Critical Thinking Tendency Scale (MCTTS)						
Reasoning Pre-Test	25.46±4.13	11.00-30.00	25.62±5.22	15.00-30.00	-180	.857
Reasoning Post-Test	24.84±3.46	6.00-30.00	22.16±5.43	12.00-30.00	1.889	.062
Test Statistic	t=.537	p[d]=.593	t= 3.324	**p[d]=.002**		
Judgement Pre-Test	25.19±3.68	14.00-30.00	25.31±5.31	17.00-30.00	-146	.884
Judgement Post-Test	24.00±8.31	6.00-30.00	21.49±5.74	12.00-30.00	1.770	.080
Test Statistic	t= 1.042	p[d]=.301	t= 3.411	**p[d]=.001**		
Evidence Seeking Pre-Test	16.84±3.04	7.00-20.00	17.18±3.04	12.00-20.00	-579	.564
Evidence Seeking Post-Test	15.91±4.66	6.00-20.00	14.33±3.93	8.00-20.00	1.878	.063
Test Statistic	t= 1.312	p[d]=.194	t= 3.862	**p[d]< .001**		
Truth Seeking Pre-Test	16.71±3.14	6.00-20.00	17.13±3.60			
Truth Seeking Post-Test	15.74±4.52	6.00-20.00	14.00±4.03	**p[d]< .001**	-668	.506
Test Statistic	t= 1.494	p[d]=.140	t= 4.153		2.092	**.039**
Open Mindedness Pre-Test	17.06±3.04	4.00-20.00	16.58±4.74	11.00-20.00	660	.511
Open Mindedness Post-Test	16.43±5.27	5.00-20.00	14.44±3.24	7.00-20.00	2.267	**.025**
Test Statistic	t=.773	p[d]=.442	t= 2.618	**p[d]=.012**		
Systematicity Pre-Test	17.06±3.11	4.00-20.00	17.07±3.29	12.00-20.00	-13	.990
Systematicity Post-Test	16.61±5.27	5.00-20.00	14.44±3.56	9.00-20.00	2.416	**.017**
Test Statistic	t=.578	p[d]=.566	t= 3.761	**p[d]< .001**		
Total Pre-Test	118.46±18.75	53.00-140.00	118.89±23.71	79.00-140.00	-106	.916
Total Post-Test	113.54±36.30	34.00-140.00	100.87±25.51	61.00-140.00	2.035	**.044**
Test Statistic	t= 1.01	p[d]=.316	t= 3.656	**p[d]< .001**		
Peer-Support Scale (PSS)						
Physical Support Pre-Test	25.03±6.93	9.00-36.00	23.87±9.33	9.00-36.00	762	.448

Physical Support Post-Test	21.97±9.22	9.00-36.00	21.71±8.85	9.00-36.00	149	.881
Test Statistic	t= 2.196	**p^d=.031**	t= 1.112	p^d=.272		
		d = 0.35				
Academic Support Pre-Test	11.16±3.27	4.00-16.00	10.91±4.31	4.00-16.00	349	.728
Academic Support Post-Test	9.32±4.39	4.00-16.00	9.56±4.03	4.00-16.00	-290	.772
Test Statistic	t= 2.899	**p^d=.005**	t= 1.499	p^d=.141		
		d = 0.45				
Emotional Support Pre-Test	10.86±3.41	4.00-16.00	9.82±4.52	4.00-16.00	1.389	.168
Emotional Support Post-Test	9.49±4.74	4.00-16.00	9.73±3.77	4.00-16.00	-286	.775
Test Statistic	t= 2.001	**p^d=.049**	t=.098	p^d=.922		
		d = 0.30				
Total Pre-Test	47.04±12.95	17.00-68.00	44.60±17.92	17.00-68.00	845	.400
Total Post-Test	40.78±18.24	17.00-68.00	41.00±16.58	17.00-68.00	-64	.949
Test Statistic	t= 2.355	**p^d=.021**	t=.970	p^d=.337		
		d = 0.40				
Self-Responsiveness to Learning Scale (SRLS)						
Self-Directedness Pre-Test	51.68±8.90	26.00-65.00	43.40±14.81	13.00-64.00	3.730	**< .001**
Self-Directedness Post-Test	64.01±6.14	58.00-91.00	39.87±12.49	22.00-65.00	13.739	**< .001**
Test Statistic	t=-9.217	**p^d< .001**	t=1.132	p^d=.264		
		d = 1.50				
Willingness to Learn Pre-Test	51.09±8.34	15.00-60.00	39.93±13.65	12.00-59.00	5.418	**< .001**
Willingness to Learn Post-Test	58.65±3.30	53.00-69.00	39.22±13.30	16.00-60.00	11.625	**< .001**
Test Statistic	t=-6.907	**p^d< .001**	t=.235	p^d=.815		
		d = 1.20				
Self-Control Pre-Test	63.03±10.87	18.00-75.00	49.38±18.48	15.00-74.00	4.965	**< .001**
Self-Control Post-Test	74.67±5.22	72.00-102.00	48.60±15.70	22.00-75.00	12.778	**< .001**
Test Statistic	t=-8.03	**p^d< .001**	t=.205	p^d=.839		
		d = 1.30				
Total Pre-Test	165.80±26.53	59.00-200.00	132.71±46.51	40.00-190.00	4.831	**< .001**
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Test Statistic	t=-8.86	**p^d< .001**	t=.511	p^d=.612		
		d = 1.60				
Locus of Control Scale (LOC)						
Personal Control Pre-Test	47.42±12.24	18.00-72.00	51.29±12.79	32.00-72.00	-1.620	.108
Personal Control Pre-Test	53.71±18.94	35.00-90.00	58.09±18.90	28.00-90.00	-1.208	.230
Test Statistic	t=-2.272	**p^d=.026**	t=-1.982	p^d=.054		
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Fatalism Post-Test	8.70±3.49	3.00-13.00	8.29±3.60	3.00-15.00	601	.549
Test Statistic	t=2.728	**p^d=.008**	t=.865	p^d=.392		
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Belief in an Unfair World	10.61±3.40	5.00-20.00	12.04±3.46	8.00-20.00	-2.191	**.031**
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Test Statistic	t=-2.219	**p^d=.030**	t=-1.249	p^d=.218		
		d = 0.35				
	n	**%**	**n**	**%**	**X^2**	**p^b**

"High Learning Ability Status" According to Self-Learning Readiness" Pre-Test	**Yes**	61	88.41	19	42.22	27.757	***< .001***
	No	8	11.59	26	57.78		
"High Learning Ability Status" According to Self-Learning Readiness" Post-Test	**Yes**	69	100	19	42.22	49.101	***< .001***
	No	0	0	26	57.78		

SD: Standard deviation, [b]Pearson qhi-square test, [c]Independent Samples t test, [d]Paired-Samples t te
Cohen's d values are reported for statistically significant within-group pre–post comparisons.

Table 4. Adjusted ANCOVA Results for Primary Outcomes

Outcomes	Adjusted Mean (Experimental)	95% CI	Adjusted Mean (Control)	95% CI	F (1,111)	p	ηp²
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Critical Thinking	113.09	105.15–121.03	100.89	91.20–110.58	3.73	.056	.033
Peer Support	40.93	36.83–45.03	40.77	35.63–45.92	0.002	.961	<.001
Self-Directed Learning Readiness	193.30	186.93–199.68	124.90	116.01–133.79	150.21	**<.001**	.575
Locus of Control	131.09	126.26–135.93	136.66	130.86–142.46	2.13	.147	.019

ANCOVA = Analysis of Covariance; ηp² = partial eta squared. All analyses were adjusted for baseline (pre-test) scores. Adjusted means are presented as estimated marginal means with 95% confidence intervals. ANCOVA assumption checks were conducted for all primary outcomes.