

The Association Between Learning Styles and Academic Achievement in Nursing Students: A Systematic Literature Review of Iranian Evidence

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ABSTRACT

Background: Learning styles are an important factor influencing the learning process. Understanding these factors is essential for designing effective educational programs based on Curry's onion ring model, particularly in Iranian nursing education where traditional teaching methods predominate. This study aimed to systematically review Iranian research on the relationship between nursing students' learning styles and academic achievement to identify prevailing patterns, methodological gaps, and implications for education.

Methods: A systematic literature search was conducted in Scopus, PubMed, Google Scholar, Scientific Information Database (SID), and Excerpta Medica Database (EMBASE) in Persian and English from January 2012 to October 2024 using the keywords "learning style," "nursing," and "student." Inclusion criteria comprised observational studies on Iranian nursing students assessing learning styles and their relationship with academic achievement or demographic variables. Conference abstracts, dissertations, qualitative studies, interventional studies, and reviews were excluded. Quality was assessed using a Newcastle-Ottawa Scale (NOS). Findings were synthesized and reported using a systematic literature review approach.

Results: Of 984 initially retrieved articles, 23 observational studies involving a total of 6,847 Iranian nursing students met the inclusion criteria. The Kolb's Learning Style Inventory (LSI) and VARK (Visual, Aural, Read/Write, Kinesthetic) models were the most frequently used frameworks. In the Kolb's model (used in 16 studies), assimilator and convergent styles were the most prevalent. In the VARK model (used in 7 studies), reading/writing was the dominant preference (n=5 studies). Evidence on the association between learning styles and academic achievement remained contradictory (positive association reported in 9 studies, no association in 10 studies, and mixed results in 4 studies).

Conclusion: Iranian nursing students most commonly showed convergent and assimilator (Kolb) and reading/writing (VARK) learning styles, although evidence on their association with academic achievement was inconsistent. Given the methodological limitations of existing studies, nursing educators are encouraged to use diverse and blended teaching strategies to address the varied preferences of learners. Future research should focus on larger multi-center studies and evaluate the impact of learning-style-based instructional approaches on academic and clinical outcomes.

Note: The protocol was registered in PROSPERO (ID: CRD42022375311); however, several deviations from the original protocol were made during the conduct of the study.

Keywords: Education, Learning, Nursing, Students, Teaching, Academic Success

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Please cite this paper as:

Rafi AR, Darabiyan P, Neshati
A, Pashmforosh M, Shaterian
N, Jamalnia S, Shaygan M,
Gheysar M. The Association
Between Learning Styles and
Academic Achievement in
Nursing Students: A Systematic
Literature Review of Iranian
Evidence. *Interdiscip J
Virtual Learn Med Sci.*
2026;17(1):1-21. doi: 10.30476/
ijvlms.2026.109221.1360.

Received: 15-10-2025

Revised: 03-01-2026

Accepted: 07-01-2026

Introduction

One of the fundamental objectives of any educational system is to provide effective and enduring learning experiences, as the success of such systems ultimately depends on learners' academic achievements (1). This is particularly important in medical and nursing education, where the quality of training directly impacts healthcare outcomes (2). The complexity of education demands an in-depth understanding of teaching and learning processes, as well as the adoption of innovative, student-centered methods (3).

An essential factor in enhancing learning outcomes is the recognition of learners' individual differences, especially their learning styles (4). Learning styles describe the ways individuals prefer to take in, process, and remember new information (5). These preferences are not indicative of intelligence, but rather reflect differences in cognitive, emotional, and physiological engagement with educational content (6). Recognizing these styles enables educators to design more effective instructional strategies and foster academic success (7).

Various theoretical frameworks have been proposed to categorize learning styles, with Curry's "onion ring" model being one of the most influential. This framework conceptualizes learning styles in multiple layers, including cognitive personality traits, information processing preferences, and instructional interactions (8). Based on this framework, applied instruments such as Kolb's Learning Style Inventory (LSI) and VARK (Visual, Aural, Read/Write, Kinesthetic) have been developed, both of which are extensively utilized in nursing education to adapt instructional strategies to learners' preferences (9, 10).

Given the nature of nursing education, which integrates theoretical knowledge with hands-on clinical practice, understanding students' learning styles is particularly important (11). Aligning teaching methods with these styles can improve learners' motivation, self-awareness, and ultimately academic performance (12). Although several

studies conducted in Iran have examined learning styles among nursing students (13-15), the findings are fragmented, and to our best knowledge, no comprehensive synthesis has yet been conducted (16, 17). Moreover, Iranian nursing education still largely relies on traditional lecture-based methods, while evidence on students' preferred learning styles and their association with academic achievement remains scattered and contradictory. This systematic literature review aimed to synthesize Iranian evidence on learning styles and their association with academic achievement in nursing students, to identify the most commonly used learning style models in the Iranian context, and to highlight gaps that can inform future educational strategies.

Methods

Study Design

This study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (11). It was designed as a systematic literature review that synthesized findings from quantitative observational studies. Noteworthy, the protocol was registered in PROSPERO (ID: CRD42022375311); however, in practice, we had to make some methods deviations from the original protocol.

Deviations from the original protocol were necessary to suit the available evidence, as the retrieved studies were predominantly observational rather than randomized controlled trials (RCTs). The main modifications were: (1) revising the search strategy to target observational studies instead of applying Cochrane filters designed for controlled trials; (2) adopting the Newcastle-Ottawa Scale (NOS) as a more suitable quality appraisal tool for cross-sectional studies, instead of Strengthening the Reporting of Observational Studies in Epidemiology (STROBE); and (3) employing a systematic literature synthesis due to study heterogeneity and their descriptive characteristics, rather than conducting the meta-analysis initially proposed in the protocol.

Search Strategy

A systematic search was performed using the keywords “learning style,” “nursing,” and “student,” applied both separately and in combination with Boolean operators (AND/OR). The search was limited to studies published between January 2012 and October 2024 to ensure the inclusion of contemporary evidence following the widespread integration of Kolb’s and VARK models in Iranian medical education research, as well as to capture studies conducted within the current curriculum framework.

The detailed search strategy, based on MeSH keywords, was as follows: (“learning style”[tiab] OR “learning style inventory”[tiab] OR “Kolb learning style inventory”[tiab] OR “Kolb learning style questionnaire”[tiab] OR “VARK”[tiab] OR “VARK questionnaire”[tiab] OR “H-PILS”[tiab] OR “Health Professionals Inventory of Learning Styles”[tiab] OR “StrengthsFinder”[tiab]) AND (“medical education”[tiab] OR “nursing education”[tiab] OR “nursing student”[tiab]).

Studies published in English and Persian within the specified timeframe were eligible for inclusion. The research question was formulated using the PEO framework, where P (Population) referred to Iranian nursing students, E (Exposure) represented learning styles, and O (Outcome) focused on academic achievement. Guided by this framework, relevant studies were identified and selected in accordance with the review objectives.

Study Selection

The screening process began with an evaluation of titles and abstracts based on predefined inclusion criteria. Subsequently, two independent reviewers assessed the full texts of potentially eligible studies. Any disagreements were resolved through discussion with a third reviewer. The selected studies were documented in a data extraction table.

Inclusion Criteria

The inclusion criteria for this review encompassed observational studies that

focused on Iranian nursing students and examined the relationship between learning styles and academic achievement. Studies were included if they examined the association of learning styles with learning quality or explored the association between demographic characteristics and preferred learning styles. Only articles published in English or Persian were considered eligible for inclusion.

Exclusion Criteria

The exclusion criteria included articles published as conference proceedings, congress abstracts, or dissertations, as these sources often lack rigorous peer review. Additionally, qualitative studies, interventional research, and review articles were excluded to maintain the focus on observational evidence directly related to the association between learning styles and academic achievement in Iranian nursing students.

Data Extraction

Data extraction was performed independently by two reviewers using a standardized form. The extracted information included the first author’s name, year of publication, gender distribution, sample size, study design, participants’ academic level or course, the learning style theory or model applied, the specific learning styles identified, and the main findings of each study. Any disagreement between the reviewers, were resolved by consulting a third reviewer to achieve consensus and ensure data accuracy and consistency.

Quality Assessment

The quality of included observational studies was assessed using the NOS adapted for cross-sectional studies (18). This tool evaluates three domains: selection (maximum 5 stars, including representativeness, sample size justification, non-respondents, and ascertainment of exposure), comparability (maximum 2 stars, based on design or analytical control of confounding), and outcome (maximum 2 stars including outcome assessment and appropriateness of statistical analyses). Studies

scoring 7–9 stars were rated as low risk of bias (good quality), those with 4–6 as moderate, and those scoring below 4 as high risk.

Data Synthesis and Analysis

A systematic literature review approach was applied to integrate qualitative and quantitative findings from the included studies. Qualitative data were categorized into key themes related to learning styles, academic achievement, and demographic influences. Quantitative data, such as prevalence rates and correlation coefficients, were summarized and presented descriptively. Contextual variables such as course level, teaching strategies, and institutional characteristics were also considered. The synthesis aimed to provide a comprehensive overview of how learning styles impact academic performance in Iranian nursing students.

Results

The study selection process is illustrated in the PRISMA flow diagram (Figure 1). A total of 984 records were initially retrieved from database searches, including Scopus, PubMed, Google

Scholar, Scientific Information Database (SID), and Excerpta Medica Database (EMBASE). After the removal of 294 duplicate entries, 690 articles remained for screening based on titles and abstracts. Among these, 616 studies were excluded due to lack of relevance to the research objectives, resulting in 74 articles being subjected to full-text evaluation. Following this assessment, 51 articles were excluded for not meeting the inclusion criteria, and ultimately, 23 studies were included in the final analysis.

The included observational studies primarily aimed to identify the most commonly used learning styles among Iranian nursing students and their relationship with academic achievement. However, the findings revealed no consensus on a single dominant learning style. According to Kolb’s model, the assimilator (19-22) and convergent (23-26) styles were most frequently reported. In contrast, two separate studies identified divergent (27, 28) and accommodative (29, 30) styles as the most preferred.

Regarding the VARK model, five studies indicated that the reading/writing style was the most common among nursing students (31-35),

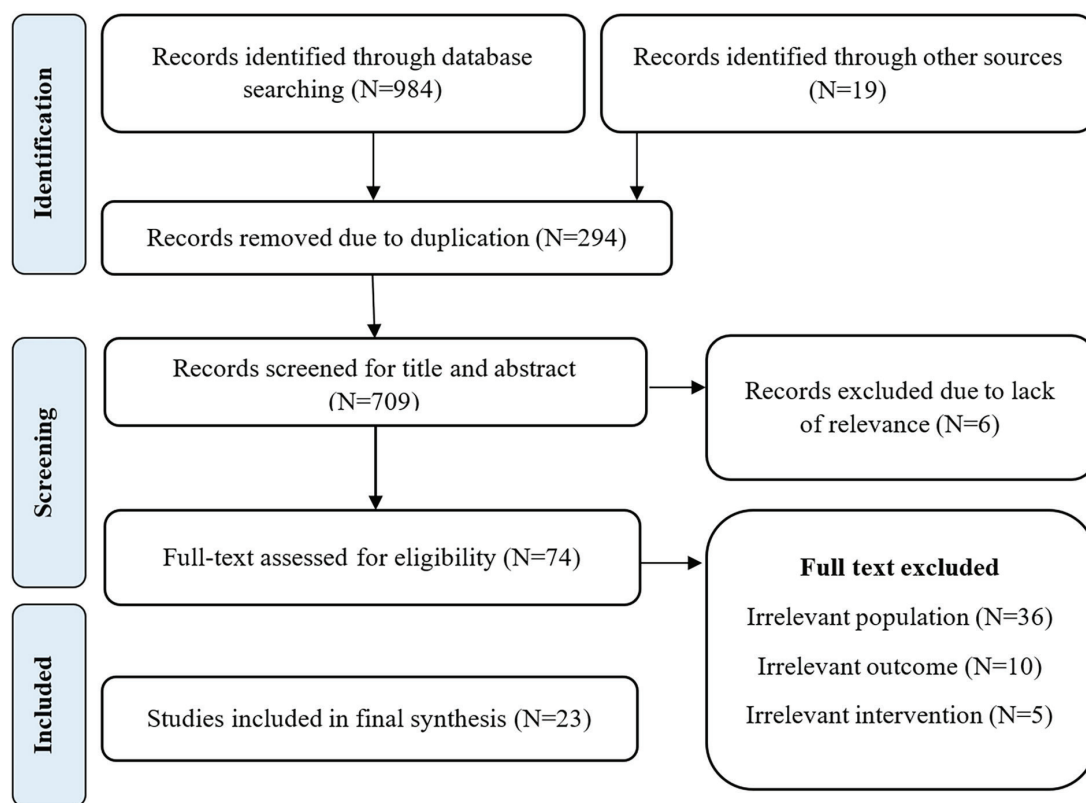


Figure 1: PRISMA flowchart of included studies

while two studies reported the auditory style as dominant (36, 37), and one study found the kinesthetic style to be the most frequently used (38). These findings suggest that nursing students often use multiple learning styles simultaneously. Therefore, it is not possible to conclude that one specific style is superior to others.

The evidence regarding the relationship between learning styles and academic achievement was inconsistent. A positive association was reported in nine studies (12, 20, 68, 72, among others), no significant association in 10 studies (21, 69, 70, 14, among others). Additionally, four studies indicated either weak or mixed relationships. Similarly, associations with demographic variables (e.g., age, gender) were inconsistent, with some studies showing links to age (32) and others none (33). An overview of the included studies is presented in Table 1.

In synthesizing these results, the systematic literature approach revealed that Kolb's model dominated the Iranian literature (applied in 70% of studies, $n=16/23$), with assimilator and convergent styles collectively prevalent in over 80% of Kolb-based studies ($n=40/50$

style mentions across studies), reflecting a preference for abstract and logical processing. In contrast, the VARK model was utilized in 30% of studies ($n=7/23$), where the reading/writing preference was dominant in 71% ($n=5/7$), indicating a textual bias potentially aligned with exam-oriented curricula. Quantitatively, prevalence rates for dominant styles ranged from 25-45% within individual studies, but aggregated data showed no overall superiority due to variability in sample sizes (median=250, range=100-800). The association with academic achievement was inconsistent, with positive correlations (e.g., $r=0.2-0.4$ in 39% of studies) often linked to matched styles in theoretical courses, while null results (43%) predominated in clinical contexts, suggesting mediation by course type and institutional factors. Demographic associations were weak overall, with age showing positive links in only 22% ($n=5/23$) of studies, possibly due to maturation effects in older students. These patterns underscore contextual influences in Iranian nursing education, with methodological heterogeneity (e.g., varying Grade Point Average (GPA) measures) contributing to discrepancies.

Table 1: Overall characteristics of the included studies

Author(s), Reference	Sample Size/Sex	Study Type	Course/Degree Program	Learning Style Theories/Models	Learning Styles Identified	Key points/Main Findings	Year
Mousavi and colleagues (14)	n=276	Descriptive-correlational	Nursing	Kolb's Learning Styles	Divergent (31.2%), Convergent (18.4%)	Significant relationship between learning styles and clinical competency ($P<0.05$). Higher clinical competency in students with accommodative and converging styles. Clinical competency score: 77.25 ± 12.65 .	2024

Author(s), Reference	Sample Size/Sex	Study Type	Course/Degree Program	Learning Style Theories/Models	Learning Styles Identified	Key points/Main Findings	Year
Kohan and colleagues (38)	n=237 (F:142, M: 95)	Cross-sectional	BSN	VARL	Kinesthetic (43.55%), Auditory (29.3%), Hybrid (11.3%), Reading/Writing (9.6%), Visual (6.3%)	Kinesthetic (57.1%) and auditory (37.2%) were the most frequently used styles. No significant relationship between learning styles and academic performance (P=0.311).	2021
Shirazi and colleagues (27)	n=139 (F: 139)	Cross-sectional	BSN	Kolb's ELT	Divergent (55.4%), Assimilator (Not Reported), Convergent (Not Reported), Accommodator (Not Reported)	Significant relationship between learning style and academic achievement (P<0.001). Divergent style was the most frequently used. Higher achievement rate among senior students (P=0.01).	2019
Sarbazvatan and colleagues (28)	n=452 (F: 303, M: 149)	Longitudinal	BSN	Kolb's ELT	Divergent (34.88%), Accommodator (30.75%), Assimilator (30.21%), Convergent (24.13%)	Lower GPA in nursing and medical students (P=0.001, P=0.015). No difference in academic achievement by learning style (P=0.17). Females tended to use accommodative, males convergent (P=0.04).	2018

Author(s), Reference	Sample Size/Sex	Study Type	Course/ Degree Program	Learning Style Theories/ Models	Learning Styles Identified	Key points/ Main Findings	Year
Ghahremani and colleagues (23)	n=208 (F: 131, M: 77)	Descriptive	BSN and MSN	Kolb's ELT	Convergent (NR), Divergent (NR) and Assimilator (NR)	Significant correlations between flexibility in learning style and reflective observation (P=0.013), abstract conceptualization (P=0.040), and active experimentation (P=0.250). Active experimentation associated with total scores (P=0.050).	2016
Abdollahimohammad and Ja'afar (39)	n=156 (F: 156)	Descriptive	BSN	NR	Perceptive (NR), solitary (NR), analytic (NR), competitive (NR), and imaginative (NR)	No significant association between learning styles and cultural values, academic year, or age (P>0.05).	2015
Gebbru and colleagues (40)	n=232 (F: 143, M: 89)	Cross-sectional	BSN	Kolb's ELT	Abstract Conceptualization (37.5%), Active Experimentation (30.17%), Reflective Observation (19.83%), Concrete Experience (12.5%)	No significant relationship between learning styles and academic achievement (P>0.05). Significant associations with gender (P<0.05), marital status (P=0.032), and academic level (P=0.041).	2015

Author(s), Reference	Sample Size/Sex	Study Type	Course/Degree Program	Learning Style Theories/ Models	Learning Styles Identified	Key points/Main Findings	Year
Moghadam and colleagues (31)	n=140 (F: 69, M: 71)	Descriptive	BSN and MSN	VARK	Reading/ Writing (43%), Kinesthetic (27%), Visual (15%), Auditory (15%)	Significant difference between learning styles and academic degree ($P < 0.05$). No significant association with demographic variables ($P > 0.05$).	2015
Nazari Vanani and colleagues (30)	n=200 (F:154, M:46)	Cross-sectional and descriptive	BSN	Kolb's ELT	Accommodator (56.6%), Divergent (37.5%), Convergent (5.5%), Assimilator (5%)	No significant association between gender and age with learning style ($P = 0.721$)	2015
Rasouli and colleagues (32)	n=160 (F:108, M: 52)	Cross-sectional		VARK	Reading/ Writing, Visual, Auditory, Kinesthetic (Not Reported)	No significant association between learning styles and gender, field of study, or interest in discipline ($P > 0.05$). Visual style was most common.	2015
Sarabi-Asiabar and colleagues (33)	n=184 (F: 122, M: 62)	Cross-sectional	MSN	VARK	Reading/ Writing (21.7%), Auditory (18.5%), Kinesthetic (6.5%), Visual (1.6%)	Significant relationship between gender and single modal learning styles ($P = 0.009$). Educational level significantly associated with learning style ($P = 0.04$). Reading/ Writing was most common.	2015

Author(s), Reference	Sample Size/Sex	Study Type	Course/Degree Program	Learning Style Theories/ Models	Learning Styles Identified	Key points/Main Findings	Year
Ghahremani and colleagues (20)	n=208 (F: 131, M: 77)	Cross-sectional	BSN and MSN	Kolb's ELT	Assimilator (54.9%), Divergent (24%), Convergent (13.1%), Accommodator (8%)	Significant association between learning style and academic achievement (P<0.05).	2015
Noohi and colleagues (24)	n=75 (F: 22, M: 53)	Descriptive	MSN and PhD	Kolb's ELT	Convergent (30.7%), Assimilator (26.7%), Accommodator (22.7%), Divergent (20%)	Association between learning style and critical thinking (P<0.0001).	2014
Alaa and colleagues (29)	n=1925 (F: 1248, M: 677)	Cross-sectional and descriptive	BSN	Kolb's ELT	Accommodator (43.1%), Divergent (35.1%), Convergent (11.9%), Assimilator (9.4%)	Significant association between learning style and academic year. No association with gender or age.	2014
Troski and colleagues (25)	n=240 (F: 161, M: 79)	Cross-sectional	BSN	Kolb's ELT	Convergent (45.4%), Assimilator (23.3%), Accommodator (17.1%), Divergent (14.2%)	Significant difference in learning styles between nursing and health school students (P≤0.05). No association with marital status, gender, semester, or age (P>0.05).	2014
Peyman and colleagues (37)	n=141 (F: 93, M: 48)	Cross-sectional	BSN	VARC	Auditory (17.7%), Reading/Writing (17%), Kinesthetic (6.3%), Visual (0.7%)	Significant association between gender and selection of visual and reading/writing styles (P=0.03). Educational level and field of study also significant (P=0.008). Auditory style most common.	2014

Author(s), Reference	Sample Size/Sex	Study Type	Course/Degree Program	Learning Style Theories/Models	Learning Styles Identified	Key points/Main Findings	Year
Azadmanesh and colleagues (34)	n=242 (F: 177, M: 65)	Descriptive	BSN and MSN	VARK	Reading/Writing, Auditory, Kinesthetic, Visual	Significant relationships between gender and academic course ($P \leq 0.05$), marital status and reading style ($P \leq 0.05$), academic course and visual and reading-writing styles ($P \leq 0.05$).	2013
Jannat Alipour and colleagues (36)	n=132 (F: 132)	Cross-sectional and descriptive	BSN	VARK	Auditory (38%), Reading/Writing (32%), Kinesthetic (24%), Visual (6%)	No significant association between learning style and age ($P=0.18$), academic year ($P=0.065$), or total score ($P=0.148$). Tri-modal was the most common learning style type.	2013
Jafari Sani (21)	n=187 (F: 137, M: 50)	Descriptive	BSN	Kolb's ELT	Assimilator (47.9%), Divergent (31.9%), Convergent (11.7%), Accommodator (8.5%)	Significant differences between frequencies of preferred styles ($P=0.000$). No difference by gender ($P=0.14$). No significant gender differences in SDLRS scores ($P=0.68$).	2013

Author(s), Reference	Sample Size/Sex	Study Type	Course/Degree Program	Learning Style Theories/Models	Learning Styles Identified	Key points/Main Findings	Year
Farmanbar and colleagues (26)	n=176	Cross-sectional and descriptive	BSN	Kolb's ELT	Convergent (NR), Assimilator (NR), Accommodator (NR) and Divergent (NR)	No significant difference between learning styles and educational progress (P=0.346).	2013
Gahremani and colleagues (19)	n=208 (F: 131, M: 77)	Cross-sectional	BSN and MSN	Kolb's ELT	Assimilator (45.7%), Divergent (28.4%), Convergent (16.8%), Accommodator (9.1%)	Significant relationship between active experimentation learning style and academic achievement (P=0.05). Assimilating and diverging styles constructive. Abstract conceptualization varied by semester (P=0.034).	2013
Peyman and colleagues (35)	n=56 (F: 28, M: 25)	Descriptive	BSN	VARK	Reading/Writing (50%), Auditory (46%), Kinesthetic (20%), Visual (12%)	Significant gender difference in use of reading/writing component (P<0.02).	2012
Ahanchian and colleagues (22)	n=187 (F: 137, M: 50)	Cross-sectional and descriptive	BSN	Kolb's ELT	Assimilator (48.12%), Divergent (32.08%), Convergent (12%), Accommodator (8.02%)	No significant gender difference in preferred learning style (P=0.14). Significant difference in academic achievement and thinking style functions by learning style (P=0.036).	2012

MSN: Master of Science in Nursing; ELT: Experiential Learning Theory; BSN: Bachelor of Science in Nursing; VARK: Visual, Aural, Read/Write, Kinesthetic; GPA: Grade Point Average; NR: Not Reported; F: Female; M: Male.

Table 2: Risk of bias assessment of included studies using the Newcastle-Ottawa Scale

No	Author(s) / Ref	Year	Selection (/5)	Comparability (/2)	Outcome (/2)	Total stars	Risk of bias
1	Kohan and colleagues (38)	2021	★★★★☆	★☆☆	★★	7	Low
2	Shirazi and colleagues (27)	2019	★★★★☆	★★	★★	8	Low
3	Sarbazvatan and colleagues (28)	2018	★★★☆☆	★☆☆	★☆☆	5	Moderate
4	Ghahremani and colleagues (23)	2016	★★★★☆	★☆☆	★★	7	Low
5	Abdollahimohammad and Ja'afar (39)	2015	★★★★★	★★	★★	9	Low
6	Gebbru and colleagues (40)	2015	★★★☆☆	★☆☆	★★	6	Moderate
7	Moghadam and colleagues (31)	2015	★★★★★	★★	★★	9	Low
8	Nazari Vanani and colleagues (30)	2015	★★★★☆	★☆☆	★★	7	Low
9	Rasouli and colleagues (32)	2015	★★★★☆	★☆☆	★★	7	Low
10	Sarabi-Asiabar and colleagues (33)	2015	★★★★☆	★★	★★	8	Low
11	Ghahremani and colleagues (20)	2015	★★★☆☆	★☆☆	★★	6	Moderate
12	Noohi and colleagues (24)	2014	★★★★★	★★	★★	9	Low
13	Alaa and colleagues (29)	2014	★★★★☆	★☆☆	★★	7	Low
14	Troski and colleagues (25)	2014	★★★☆☆	★☆☆	★★	6	Moderate
15	Peyman and colleagues (37)	2014	★★★★☆	★★	★★	8	Low
16	Azadmanesh and colleagues (34)	2013	★★★★☆	★★	★★	8	Low
17	Jannat Alipour and colleagues (36)	2013	★★★☆☆	★☆☆	★★	6	Moderate
18	Jafari Sani (21)	2013	★★★★☆	★★	★★	8	Low
19	Farmanbar and colleagues (26)	2013	★★★★☆	★☆☆	★★	7	Low
20	Ghahremani and colleagues (19)	2013	★★★★☆	★★	★★	8	Low
21	Peyman and colleagues (35)	2012	★★★★☆	★★	★★	8	Low
22	Ahanchian and colleagues (22)	2012	★★★★☆	★★	★★	8	Low

As noted previously, the quality of the included observational studies was evaluated using the NOS. Overall, 12 studies (52%) were categorized as low risk, 9 (39%) as moderate risk, and 2 (9%) as high risk of bias. Common issues included lack of justification for sample size and non-response rates. Detailed NOS scores for each study are presented in Table 2.

Discussion

This systematic literature review synthesized evidence from 23 observational studies on the association between learning styles and academic achievement among Iranian nursing students. The main findings indicate that Kolb's model was predominant, with assimilator and convergent styles most common, while the VARK highlighted reading/writing as the leading preference. According to the current study findings, the evidence regarding the direct relationship between learning styles and academic performance remains inconclusive. While several studies indicated a positive correlation

(19, 27, 41), others found no significant association (28, 40, 42). A study confirmed a positive link for deep/strategic styles but negative for surface styles, suggesting mismatched styles (e.g., abstract-dominant in practical settings) may explain inconsistencies, mediated by factors like curriculum design and engagement (43). This multifactorial nature implies that learning styles alone do not predict achievement; instructional quality and environment play key roles (44).

Moreover, findings regarding the association of learning styles with demographic variables were also mixed. While some research indicated a significant association between factors such as age and learning style (45, 46), others reported no such correlation (14, 47), highlighting the complexity of this relationship.

In the Iranian context, the prevalence of convergent and assimilator styles (Kolb) and reading/writing (VARK) may reflect the lecture-heavy, theoretical focus of nursing curricula, which favors abstract

conceptualization and logical processing over hands-on experimentation (48). This contrasts with the practical demands of clinical nursing, potentially explaining why kinesthetic styles were less common despite the field's emphasis on skills.

Learning style preferences among nursing students show considerable variation across different cultural and geographical settings. For instance, Australian and Jordanian students tended to prefer the kinesthetic style (49-51), while Malaysian nursing students showed a preference for the visual style (52). In contrast, studies from Nigeria and Saudi Arabia found that diverging and converging learning styles based on Kolb's model were more prevalent (53, 54). These variations are likely influenced by cultural diversity, educational systems, and individual learning needs (55). Moreover, immigrant students have shown a tendency to favor convergent styles (56), and gender-based differences have also been observed—males often prefer analytical approaches, while females tend to emphasize relational and experiential processing (57).

These variations may be attributed to cultural influences. In Iran, an educational focus on memorization and examination tends to favor reading, writing, and abstract learning styles, whereas Western and some Asian programs integrate more experiential, student-centered methods that encourage kinesthetic and visual approaches (58). A comparative study of Iranian and Malaysian nursing students found Iranian students favored unimodal styles more than multimodal ones in Malaysia, attributed to cultural collectivism influencing group-based learning (59). Alignment is stronger with Middle Eastern contexts due to similar educational structures, but divergences from Western countries highlight the need for culturally tailored interventions.

Within the VARK model, auditory learners thrive through listening, discussion, and verbal feedback (60). This model provides a practical framework for identifying sensory preferences in learning (61). However, despite

nursing being a practical discipline, some studies found that kinesthetic styles were less preferred (62, 63). This paradox may be attributed to factors such as the rise of e-learning, cultural and age differences, and varied physical or cognitive conditions among students (35, 64). Furthermore, the design of educational programs and the presence of social interaction within learning environments significantly shape style preferences (65, 66). The increasing integration of e-learning has posed challenges for implementing kinesthetic learning approaches. For instance, limited social presence and a lack of real-time feedback in virtual environments may hinder learners' ability to express their needs and cope with difficulties (67). Learning preferences have also been linked to intelligence and cognitive abilities, underscoring their role as indicators of individual differences (68). Consequently, diversified teaching methods, such as cooperative learning, simulations, role-playing, and gamification, are essential to accommodate these differences and deepen the learning experience (69).

While the VARK model provides a useful framework, it has limitations, including not fully accounting for motivational or emotional factors such as engagement and enthusiasm (70). Nonetheless, it remains a valuable tool for tailoring instruction to sensory preferences, especially when integrated with adaptable and student-centered curricula (71). Notably, changes in academic content or instructional delivery can also influence students' preferred learning styles (32). Several studies included in this review reported that the accommodator style, which combines active experimentation and concrete experience, was common among Iranian nursing students (29, 30, 65, 72). The assimilator style was also frequently observed, emphasizing abstract conceptualization and reflective observation—traits that favor logical analysis and theoretical modeling (73). However, this style may be less suitable for domains requiring interpersonal interaction, such as healthcare (74).

Some evidence pointed to a preference

for multi-modal or tri-modal learning styles among nursing students, which aligns with findings from a Chinese study (36, 55). In contrast, a study among Iranian dental students found a preference for single-mode styles (75). This inconsistency may be justified by disciplinary differences; nursing's blend of theory and practice encourages multimodal flexibility for clinical integration, while dentistry's technical focus suits unimodal precision. Additionally, nursing students' exposure to diverse clinical rotations promotes adaptability, unlike dentistry's more standardized lab work (76). It has been suggested that freshmen are more likely to use multi-modal styles, while senior students gravitate toward a dominant style (77). Multimodal learners tend to absorb information from multiple sources, contributing to deeper conceptual understanding (78).

Overall, the findings highlight the need for nursing educators to be aware of their students' learning preferences and to incorporate a variety of instructional strategies accordingly (79-81). Elite learners often adapt flexibly to various styles, which may enhance professional development and clinical competence (82, 83). Furthermore, the integration of e-learning with traditional learning approaches has been shown to increase student satisfaction and academic achievement (84, 85).

These inconsistencies in associations can be justified by several factors. Methodological variations, such as differing sample sizes, learning style instruments, and academic achievement metrics (e.g., GPA vs. exam scores), likely contributed to divergent results. For instance, positive associations were more common in studies with theoretical focus, where assimilator styles aligned with lecture-based teaching, whereas null findings predominated in clinical-oriented studies, indicating a mismatch between preferred styles and practical demands. Culturally, Iran's emphasis on rote memorization may amplify abstract styles but undermine kinesthetic ones, leading to weaker associations in hands-

on settings. Internationally, this mirrors broader debates on learning style theories, where critics argue styles are not fixed and may be confounded by motivation or teaching quality. Thus, the mixed evidence suggests that while styles inform preferences, their association with achievement is moderated by contextual elements, urging Iranian educators to prioritize adaptive, blended approaches over rigid style-matching.

Limitations and Suggestions

Despite the comprehensive nature of this review, several limitations must be acknowledged. First, the literature search was limited to studies published in English and Persian, which may have excluded relevant findings published in other languages. Additionally, grey literature, such as dissertations, theses, conference proceedings, and unpublished studies, was not included, potentially leading to publication bias. Furthermore, the focus was solely on nursing students, limiting the generalizability of findings to students in other health-related disciplines. Some included studies had methodological shortcomings, such as small sample sizes and limited generalizability. Inconsistencies in findings may also arise from imprecision in learning style measures and varying GPA definitions across studies. Nevertheless, many studies utilized quantitative designs, which allowed for statistical comparisons and more objective interpretations.

Conclusion

This review, aligned with its objectives to synthesize Iranian evidence on prevalent learning styles and their association with academic achievement in nursing students, found that Kolb's assimilator and convergent styles, along with VARK's reading/writing preference, are most common. However, the association between these learning styles and academic achievement remains inconsistent, with evidence showing positive, null, or mixed relationships across studies. This suggests that while learning styles

provide insights into preferences, they do not consistently predict or correlate with academic outcomes, likely due to mediating factors such as curriculum design, teaching methods, and individual motivation. These findings highlight a potential misalignment between traditional lecture-based methods in Iranian nursing education and students' diverse preferences. Therefore, educational interventions should incorporate student-centered strategies that promote self-directed learning and accommodate multiple styles. To enhance learning outcomes, it is essential for nursing educators to recognize and adapt to the diverse learning preferences of their students.

Future research should include larger and more diverse populations to enhance the generalizability of findings. Cross-cultural studies are particularly encouraged to examine how contextual and cultural factors influence learning style preferences. Additionally, innovative teaching methods, such as interactive simulations, blended learning, and adaptive e-learning technologies, should be explored to accommodate a broader range of learning needs. Ultimately, tailoring educational strategies to students' preferred learning styles may contribute not only to improved academic achievement but also to better preparation for clinical practice and lifelong learning.

Abbreviations

ELT: Experiential Learning Theory

LSI: Kolb's Learning Style Inventory

NOS: Newcastle-Ottawa Scale

VARK: Visual, Aural, Read/Write, Kinesthetic

Acknowledgments

The authors declare that no generative or large language model (such as ChatGPT or similar tools) was used to generate the content of this manuscript. AI tools were only used for minor language and grammar checking, under the authors' supervision. All ideas, analyses, and references are entirely the authors' own work.

Authors' Contribution

AR and SJ conceived and designed the study. AR, PD, NS, and MP were responsible for data collection, screening of studies, and data extraction. AN and MG contributed to the methodological design and data analysis. SJ and MS provided supervision throughout the study process and contributed to the interpretation of findings. AR drafted the initial version of the manuscript. SJ, MS, MG, and AN critically revised the manuscript for important intellectual content and improved its scientific rigor. All authors reviewed, edited, and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Conflict of Interest

The authors declare no competing interests.

Ethical Considerations

All data were derived from previously published studies, and proper citation and acknowledgment of original sources were ensured to avoid plagiarism and maintain academic integrity. The study protocol was reviewed and approved by the Research Ethics Committee of Behbahan University of Medical Sciences, Khuzestan, Iran (Ethics Code: IR.BHN.REC.1402.037). Furthermore, the authors adhered to principles of transparency, accuracy, and responsible reporting throughout the review process.

Funding/Support

This study was funded by Behbahan Faculty of Medical Sciences, Behbahan, Khuzestan, Iran.

Availability of Data and Materials

All data is derived from previously published studies, which are appropriately cited within the article. No analytic code was used, as this study was based on a systematic synthesis of the literature without computational analysis.

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