

REVIEW

A Systematic Review of Learning Style Framework Use in Health Sciences Education

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Objectives. To review the literature regarding the use of learning style frameworks in health science education, with particular attention to learning outcomes and use for self-awareness.

Findings. Of the 415 articles identified in the initial search, 31 articles involving learning style frameworks were included after screening titles, abstracts, and full texts. Multiple learning style frameworks, including VARK, Kolb Learning Style Inventory, Honey and Mumford Learning Style Questionnaire, and Pharmacist Inventory of Learning Styles, were used in various health science education disciplines, including medicine, nursing, and pharmacy. Most publications were descriptive in nature, reporting the learning styles of the given student cohort. Most studies that attempted to find a correlation between learning style and learning outcomes found none; if a correlation was found, it was weak or inconsistent with other published studies. No identified studies described use of learning style frameworks for increasing self-awareness in learners.

Summary. While a number of different learning style inventories have been used in health science education students, their utility for predicting learning outcomes appears to be weak. Using learning style inventories to improve learner self-awareness is an unexplored area of education and research.

Keywords: health science education, learning style, affective domain

INTRODUCTION

Self-awareness, which includes being aware of one's knowledge, attitudes, behaviors, and emotions, is a foundation on which successful professional development is built.¹ Self-awareness is an element of emotional intelligence and plays into the ability to provide effective patient care.¹⁻³ Therefore, having self-awareness is crucial for pharmacists and pharmacy learners. The 2016 Standards for the entry-level Doctor of Pharmacy degree programs published by the Accreditation Council on Pharmacy Education contain self-awareness as an essential component.⁴ Since the release of Standards 2016, there have been a number of publications examining ways to assess, document, and improve student pharmacist self-awareness,^{3,5} but there has not been one method that seems to work for all colleges and schools of pharmacy.

Learning style frameworks have been used by educators with learners at different educational levels in attempts to improve the learners' learning ability. Learning styles can be defined as "the manner in which individuals choose to or are inclined to approach a learning situation."⁶ A number of learning style frameworks have been described in the literature, including the VARK (Visual, Aural, Read/Write, Kinesthetic) model, the Kolb Learning Style Inventory (LSI), the Honey and Mumford Learning Style Questionnaire (LSQ), the Pharmacist Inventory of Learning Styles (PILS), the Gregorc Style Delineator (GSD), the Grasha-Reichmann Student Learning Style Scale (GRSLSS), and the Productivity Environmental Preference Survey (PEPS). Some learning style frameworks, such as VARK, focus on how learners obtain information, usually through the senses. Particularly in the VARK framework, learners can commonly have multiple preferences, termed multimodal.^{7,8} The Kolb LSI, PILS, and Honey and Mumford LSQ assess learners based on how they perceive experiences,⁹⁻¹³ with PILS being developed specifically for pharmacists and pharmacy learners.^{12,13} The GSD assesses perception and ordering,^{14,15} while GRSLSS assesses learning style in relation to interaction with others.¹⁶ PEPS evaluates how learning preference and environmental factors affect learning.¹⁷ A description of each learning style and the corresponding learning preference(s) is included in Table 1.

Given the number of easily accessible learning style frameworks, they are attractive tools for educators to improve learning or other outcomes. However, it is unknown if any learning style framework could be used as a tool for

increasing a professional degree learner's self-awareness. The objective of this systematic review was to identify the ways in which learning style frameworks have been used in pharmacy and other health science education, with a focus on their use for enhancing student self-awareness.

METHODS

Multiple databases, including PubMed (1966 -), Ebsco's CINAHL® (1982 -), Education Full Text (1983 -), and Professional Development Collection™ (1930 -), ProQuest's ERIC database (1966 -), and Web of Science™ (1864 -) were searched in November 2018. The database search was in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.¹⁸ The searches utilized subject headings and truncated, phrase-searched (as appropriate) keywords for the concepts of personality and learning style assessment and health professions. Sample search terms included "learning style," "learning style inventory," "Kolb learning style inventory," "VARK," and "PILS." The search included multiple health science education disciplines, including medicine, pharmacy, dentistry, nursing, veterinary medicine, physician assistant, occupational therapy, physical therapy, dietetics, speech language pathology, and allied health professions. A sample PubMed search string is included in Appendix 1. No date restrictions or limitations on study type were used in the search, but the limit of English language was used. Additionally, key pharmacy education journals were hand searched using the term "learning style."

After removal of any duplicate abstracts, two authors independently reviewed the titles and abstracts to ensure relevance to learning style and/or personality framework use in health science students. Any discrepancies were discussed until consensus was reached. Full text versions of the articles were evaluated based on pre-set inclusion/exclusion criteria. These criteria included use of a learning style or personality framework in health science education students. Exclusion reasons applied for both the title and abstract and full text review included no students included in the study, no learning style or personality framework used, only undergraduate non-health professions students included, article not in English, validation of instrument study, no full-text available, and article type was a commentary. Articles were further divided based on the type of framework used: learning style, personality, or both.

Extracted data from included articles included citation details, study type, type of health science study included, learning style and/or personality framework used, and any outcomes reported (learning or non-cognitive). Articles utilizing the same framework were grouped and evaluated for how the framework was used in health science students.

RESULTS

After the initial databases search, there were 415 articles. After removing duplicates, 302 unique results remained. After review of titles and abstracts, the authors agreed on inclusion/exclusion of 272 of 302 titles/abstracts (90% agreement). For the 30 discrepancies, the screening authors came to a consensus about inclusion/exclusion. The most common discrepancy involved articles that included only applicants to a health science education program and no currently enrolled students; during discussion, the authors decided to exclude these articles. 142 articles were excluded at this step, with 160 articles remaining requiring a full text review. Of these articles, 59 were excluded after applying the inclusion/exclusion criteria to the full texts. This left 101 articles: 30 used at least one learning style framework, 70 used at least one personality framework, and one used both a learning style and a personality framework. A summarized search strategy is included as a PRISMA diagram in Figure 1.

Of the articles identified involving learning style frameworks, seventeen used the VARK framework alone, five used Kolb alone, two used VARK and Kolb, one used both VARK and Honey and Mumford LSQ, two used Honey and Mumford LSQ alone, one used PILS alone, one used GSD and PILS, one used GRSLSS alone, and one used PEPS alone. Table 2 summarizes the most commonly reported learning style preference within each framework by health science discipline student type. Table 3 shows select results of studies using learning style frameworks.

Of the articles that used the VARK framework alone, eleven publications involved medical students, three publications involved nursing students, two publications involved dental students, and one publication involved pharmacy students. Most identified publications were descriptive in nature, employing a cross-sectional study design by administering the VARK assessment one time in a given student cohort. These studies most commonly found that students preferred a multimodal approach to learning, as shown in Table 2. Four of the six studies attempting to find a correlation between the VARK framework and an academic outcome (grades on a specific assessment, ability to perform a skill) did not find a significant correlation, as shown in Table 3.¹⁹⁻²² These studies were cross-sectional in nature, assessing VARK preference one time and comparing those results with an academic outcome.¹⁹⁻²² The two studies that found a significant correlation between a VARK preference and a learning outcome were conducted by Kim and Gilbert and Paiboonsithiwong and colleagues.^{23,24} Kim and Gilbert surveyed 62 applicants to a general surgery residency program and found that medical students with an aural learning preference performed better on the United States Medical

Licensing Exam Step 1 and 2 exams compared with kinesthetic or multimodal preferences.²³ Additionally, they found that those with a visual preference had higher Step 1 scores than those with a kinesthetic preference.²³ The study found no other significant differences. Paiboonsithiwong and colleagues surveyed 140 first year medical students and found that medical students with a kinesthetic preference had lower GPAs in the first semester, but found no other differences among learning preferences, including in second semester GPA.²⁴ They also found no differences between VARK preference and Perceived Stress Scale score.²⁴ None of the identified studies described how learners used the results for self-awareness.

Of the reports that used the Kolb Learning Style Inventory alone, two involved nursing students, one involved dental students, one involved orthopedic residency applicants, residents, and faculty, and one involved pharmacy students. Two of the studies were descriptive, cross-sectional studies that identified the breakdown of Kolb preferences in their cohorts.^{25,26} One of the three studies that attempted to correlate Kolb preference with a learning outcome found no association between dental students' learning style preference and either GPA or the senior students' choice of specialty practice.⁹ The other two studies attempting to find a correlation were conducted by Shinnick and Woo and Tsingos and colleagues.^{27,28} Shinnick and Woo conducted a cross-sectional study in 161 nursing students and found that students who were classified as assimilators had the highest increase in pre-test to post-test score after a heart failure simulation (mean change of 16.67 points), compared to students who were classified as other learning styles (mean change of 7 points).²⁷ Tsingos and colleagues surveyed pharmacy students and found a significantly higher academic performance in a social pharmacy course among those students who prefer to use reflective observation to process information, which are the diverger and assimilator preferences (64.07 for reflective observers, 61.46 for non-reflective observers).²⁸ None of the identified publications described how the learning style results were used by learners to develop self-awareness.

Two studies used both VARK and Kolb, and both involved nursing students. One study was descriptive and cross-sectional in nature, characterizing the preferences of Master's level nursing students.²⁹ Mitchell and colleagues looked at how learning preference changed over one semester, administering the VARK and Kolb assessments at the beginning and end of the semester to 96 nursing students. On the VARK assessment, 45% of the learners stayed the same preference, but 30% became more multi-modal.³⁰ On the Kolb assessment, there was a 40% increase in the number of diverging preferences, with 57% of the students overall changing learning preference.³⁰

Two studies used the Honey and Mumford LSQ, one in pharmacy and chemistry students and one in medical students, and one study used the LSQ in combination with VARK in medical students. Bhalli and colleagues surveyed 77 medical students to determine not only their learning style preference, but also their preferred instructional strategies.³¹ They found that active learning strategies were preferred, but there was no correlation between LSQ preference and preferred instructional strategy.³¹ Sharif and colleagues investigated the difference in learning styles and learning outcomes between 275 first year pharmacy students and 127 first year chemistry students.³² They found that reflectors and theorists tended to do better on first year exams, whereas activists tended to do worse on first year exams; however, the Pearson coefficients found were small (0.2 for reflectors and -0.2 for activists).³² There was no relationship between learning style and second, third, or fourth year exams.³² O'Mahony and colleagues explored if LSQ and/or VARK preference was associated with grades in anatomy or clinical skills assessment grades in 327 medical students.³³ There were no significant associations between any kind of preference and grades in clinical skills assessment.³³ There was an association between activist type and poorer anatomy scores, as well as between aural preference and better anatomy scores.³³ However the R^2 value was only 0.16, revealing that these preferences did not account for significant variability in the grades.³³ None of the identified studies described how students used the results for self-awareness.

PILS was used in two studies in pharmacy students. One study used both PILS and GSD to compare learning styles between pharmacy students and faculty members,³⁴ and the most common student preferences are included in Table 2. Robles and colleagues used PILS to identify learning styles of both pharmacy students and pharmacy preceptors as well as any impact on learning when the preceptors and students had matched learning styles versus unmatched learning styles.¹³ There were no significant differences in either subjective (competency assessment) or objective (final examination) evaluations by preceptors of students with matched versus unmatched learning styles.¹³ There was no description of how the pharmacy students used their PILS and/or GSD results for self-awareness.

Novak and colleagues compared second year pharmacy students' GRSLSS before and after a problem-based learning (PBL) experience in a cross-sectional study.¹⁶ There was a significant increase in the number of students with the avoidant learning style and a significant decrease in those with the participant learning style.¹⁶ The publication did not describe how the results were shared with students for self-awareness.

Hallin described the differences in PEPS in nursing students between two campuses and over multiple semesters.³⁵ Overall, there was only one difference in preference: tactile preference was more preferred at one campus.³⁵ The most common preference differed for most semesters.³⁵ The authors did not describe how the nursing students used the results for self-awareness.

DISCUSSION

Multiple learning style frameworks have been used in different health science education disciplines, as evidenced by this systematic review. Most of the identified published studies merely described the learning styles of a given population of learners (and possibly other groups too) with no assessment of learning outcomes. For those studies that attempted to correlate learning style and a learning outcome, there often was no correlation, and if a correlation was present, the correlation tended to be weak. This finding is consistent with learners across different levels of education, which has given rise to criticism of the use of learning style frameworks for predicting learning outcomes in education entirely.³⁶⁻³⁸ Therefore, these results should give pharmacy educators pause in using learning style frameworks to assess or predict any learning outcomes at a class level.

What was notably absent in all of the identified published studies was how the classification of learning style was used by the learner in attempting to increase self-awareness or metacognition. For example, none of the identified studies described the learner's reaction to discovering their learning style or if identification of a learning style influenced the way the learner studied, changed the way the learner preferred to study, or helped the learner improve their own personal learning results. These are outcomes that could be explored in future research using any or all of the learning style frameworks identified in this review. An additional future avenue of research would be to conduct a broader systematic review of other educational literature, including educational psychology literature, for guidance on how learning style frameworks might be applied to professional health science education students. For example, Howard Gardner's Multiple Intelligences, a theory similar to learning styles, has been applied to many K-12 educational settings to foster learning in different modalities, but there is no direct evidence from this review of use of his theories in health science education.^{39,40}

One of the strengths of this review is the inclusion of all health science education disciplines and not limiting to just pharmacy education. An additional strength was the search of multiple databases, not just limiting to PubMed. One of the limitations of the study is the possibility of missing some relevant studies because they were not indexed in the searched databases, although a hand search of selected pharmacy education journals was conducted to try to limit this risk. Additionally, the literature search was conducted in November 2018, so publications that are more recent would not have been found in the formal search process. Since the completion of the formal literature search, the authors have scanned the table of contents and lists of articles published ahead of print for selected pharmacy education journals to identify any reports published since the search; the authors have not identified any relevant publications in this time period.

CONCLUSION

A wide range of learning style framework use in health science education was identified. Most of the publications identified were descriptive studies and others had little impact on educational outcomes. Given that there is little published data in health sciences education on effective ways to use learning style frameworks and a complete lack of information on their use to improve student self-awareness, future directions for research should seek to answer these questions.

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