Learning Style Preference and Student Aptitude for Concept Maps

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ABSTRACT

Acknowledging that individuals' preferences for learning vary, faculty in an undergraduate nursing program questioned whether a student's learning style is an indicator of aptitude in developing concept maps. The purpose of this research was to describe the relationship between nursing students' learning style preference and aptitude for concept maps. The sample included 120 undergraduate students enrolled in the adult health nursing course. Students created one concept map and completed two instruments: the Learning Style Survey and the Concept Map Survey. Data included Learning Style Survey scores, grade for the concept map, and grade for the adult health course. No significant difference was found between learning style preference and concept map grades. Thematic analysis of the qualitative survey data yielded further insight into students' preferences for creating concept maps.

The ability to think critically is an essential attribute for today's nurses, and the development of this skill in nursing students requires multiple approaches and techniques. Concept maps have been used to develop this skill in a variety of settings and at many levels. Initially, we used the tool as a way to tutor students who were having difficulty in their senior adult health course. The use of concept mapping was then extended and used as a teaching tool for all students in the course and as one way to evaluate students' understanding of key concepts in the course. Students were required to complete concept maps, which were then graded, in both theory and clinical classes.

On the basis of student feedback, the concept map approach was introduced at an earlier level during the junior year. It was at this point that student feedback prompted us to examine the possibility that this approach may be useful to students with certain learning attributes or styles. This study explored this issue in relation to our current student population.

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LITERATURE REVIEW

Critical Thinking

Schools of nursing across the United States have been mandated to produce critical thinkers. Graduates of schools accredited by the National League for Nursing (NLN) are required to demonstrate critical thinking and problem solving skills (NLN Accrediting Commission, 2002). Critical thinking is also identified as a core competency in the American Association of Colleges of Nursing's (1998) *The Essentials of Baccalaureate Education for Professional Nursing Practice.*

The National Council of State Boards of Nursing (NCSBN) voted in December 2003 to raise the passing standard for the NCLEX-RN® examination, effective April 1, 2004. This decision was made in response to changes in the U.S. health care system in which nurses are caring for patients who are more critically ill. Therefore, the need to ensure safe and effective entry-level practice of nurses drove the need for novice practitioners to demonstrate a higher level of knowledge (NCSBN, 2003).

Although the outcome of critical thinking for nursing school graduates is well established, what exactly is this phenomenon of critical thinking? A Delphi study to

define critical thinking was sponsored by the American Philosophical Association (1990). Forty-six experts from a variety of disciplines participated in the study, and the definition that emerged described critical thinking as a "process of purposeful, self-regulatory judgment" (as cited in Staib, 2003, p. 499). Key outcomes of critical thinking were identified as interpretation, analysis, evaluation, and inference. An important indicator of critical thinking is the ability to provide the rationale for one's judgment.

In 2000, Scheffer and Rubenfeld replicated the American Philosophical Association study in nursing. The researchers queried critical thinking experts among nurses in 9 countries and 23 states in the United States. The nursing group identified the essential cognitive skills that underlie critical thinking; several of these overlap those identified by the American Philosophical Association group. In addition, the nursing group expanded the definition of critical thinking by listing "habits of mind" exhibited by critical thinkers in nursing. These habits, which include creativity, flexibility, intuition, and reflection, are particularly relevant for the kinds of problem solving situations encountered by nurses.

Nursing faculty have struggled with selecting innovative educational strategies that are effective methods for teaching these higher-level thinking skills, including application, synthesis, problem solving, and critical thinking. Possession of these skills is essential not only for the transition from student to practitioner but also for the safe and effective care of clients in today's health care environment. Staib (2003) reviewed nursing literature from 1996 to 2002 to identify seven teaching strategies designed to facilitate critical thinking skills in students. One of these strategies, concept mapping, is discussed in this article.

Concept Maps

On the basis of Ausubel's (1968) assimilation theory, Novak and Gowin (1984) proposed concept mapping as a strategy to engender meaningful learning. Meaningful learning integrates learners' prior knowledge with new concepts and ideas (Ausubel, 1968). Students always bring some experience or knowledge to a situation; teachers should recognize this and use it as fuel to ignite the desire for new knowledge acquisition (Novak & Gowin, 1984).

Concept maps provide students with an understanding of the structure of knowledge (Daley, Shaw, Balistrieri, Glasenapp, & Piacentine, 1999). Concept maps are visual representations of students' interpretation of a situation. Students create maps by linking previously acquired knowledge with newly obtained concepts, forming valid relational propositions. Construction of a theoretically correct map requires students' active involvement in organizing and analyzing data, correlating appropriate information, and synthesizing ideas. This dynamic engagement facilitates meaningful learning.

Wheeler and Collins (2003) suggested that meaningful learning is necessary for the development of higher-level thinking skills. Concept maps have been used to encourage these skills in elementary school language classes (Chang, Sung, & Chen, 2002) and in science classes (Brown, 2002). Teachers of college-level science courses have engaged this strategy as well (Gahr, 2003; Wilkes, Cooper, Lewin, & Batts, 1999). Because of the value of concept mapping in practice disciplines, both medical (West, Pomeroy, Park, Gerstenberger, & Sandoval, 2000) and nursing education have adopted concept mapping as a way to facilitate the understanding of theory and the internalization of concepts, challenging the traditional methods of rote memorization and passive learning.

Nurse educators have experimented with the use of concept mapping in various settings. Nursing staff development educators are able to use this method for new graduate orientation and preceptor workshops (Luckowski, 2003). This strategy has found its way into the conventional college classroom as a way to teach theoretical topics (Akinsanya & Williams, 2003; All, Huycke, & Fisher, 2003; Logan, 2001). Concept maps have been used in the clinical area both to prepare students for direct patient care (Baugh & Mellott, 1998; Logan, 2001; Wheeler & Collins, 2003) and to demonstrate clinical learning in lieu of traditional care plans (All et al., 2003; Castellino & Schuster, 2002; Logan, 2001; Schuster, 2000).

Studies investigating the effectiveness of concept mapping in promoting critical thinking have demonstrated positive results. In a quasi-experimental study of 76 nursing students, Wheeler and Collins (2003) found a significant increase in critical thinking ability, as measured by the California Critical Thinking Skills Test, in students creating clinical concept maps, compared with students writing traditional care plans. Baugh and Mellott (1998) queried clinical nursing students whose traditional care plan assignment was replaced by concept map creation. Students spoke favorably of the map assignment, noting it stimulated thinking and synthesis of concepts.

Faculty interviewed by Logan (2001) identified the usefulness of concept map creation by upper-level nursing students. Faculty reviewing concept maps said they were able to easily recognize student misconceptions in cause-effect relationships between pathophysiological principles and nursing care. Castellino and Schuster (2002) studied 19 advanced medical-surgical clinical nursing students using clinical concept mapping and their faculty. Both faculty and students identified that the:

> concept maps enabled a holistic view of the patient and covered all patient problems and students learned to integrate and understand relationships between patient problems.... Both faculty and students found concept maps an effective strategy in...developing critical thinking skills. (p. 149)

Learning Style Preference

A variety of teaching strategies exists for developing critical thinking skills in students (Staib, 2003). But how do teachers know which strategies will most benefit students? One approach is to identify students' learning styles. Several models of learning style have been proposed; one of the more widely used is that developed by Kolb (1976, 1985). Kolb hypothesized that individuals

have preferences for *grasping* information and for *transforming* information into meaningful learning. Individuals tend to prefer taking in new information through either *abstract conceptualization* or *concrete experience.* Information is then integrated through *reflective observation* or *active experimentation.* The four endpoints of the two dimensions can be used to create a matrix of four learning styles, which Kolb designated as *accommodator, diverger, converger,* and *assimilator.*

Kolb's model, as well as those developed by others, suggests two approaches to using learning styles. Learning styles can be matched to teaching strategies to maximize students' comfort in the learning situation, or teaching strategies can be deliberately mismatched to students' learning styles to increase their repertoire of learning skills.

Hayes and Allinson (1996) reviewed research on the matching hypothesis to investigate the influence on learning outcomes. They examined 19 studies, most of which sampled engineering or management students. In 12 of the studies, learning outcomes were positively affected when teaching strategies were matched to learning styles. They found evidence in other studies that students had greater enthusiasm and positive attitudes toward the learning situation when the teacher's learning style matched their own. However, the authors did not uncover research into the effects of mismatching learning style and teaching strategies and advocated studies to explore this area.

Loo (2004) found a weak relationship between learning styles and preferences for teaching strategies among 201 undergraduate management students. Loo advocated using a variety of learning methods, rather than attempting to match. Similarly, Vaughn and Baker (2001) supported the use of a variety of teaching styles in medical education to expose students to ways of learning that are both familiar and unfamiliar to them. Their premise is that learners who become comfortable with multiple strategies will have more tools to be successful in a variety of learning situations.

A few researchers have investigated learning styles and teaching strategies among students in the health professions. Freeman and Tijerina (2000) investigated the relationship between learning style, as measured by Kolb's Learning Style Inventory, and two methods of delivery (traditional classroom and distance learning) among junior-level students in a physician assistant program. They found no influence of the two variables on learning outcomes. Similarly, Engleberg, Schwenk, and Gruppen (2001) found that although learning style affected self-reported preferences for teaching strategies before a microbiology/infectious disease course for second-year medical students, there was no influence on learning outcomes. Furthermore, learning style had negligible influence on students' preferences for teaching strategies by the end of the course.

Laight (2004) examined the influence of learning style on students' perceptions of the usefulness of concept mapping in an undergraduate pharmacology course. The relationship was not statistically significant, and Laight concluded that concept mapping might be a useful strategy for students with a variety of learning styles. No previous research was found that examined the effect of learning style on the ability of students in a health professions program, such as nursing, to create concept maps.

PURPOSE

The purpose of this correlational, descriptive study was to describe the relationship between nursing students' learning style preference and aptitude for concept mapping. The research question for this study was: What is the relationship between learning preference and the student's aptitude for concept mapping?

METHOD

Setting and Sample

The study was conducted at a private Catholic university in a large city in the midwestern United States. The undergraduate program in the school of nursing has an enrollment of 370 students, with 96% women and 4% men. Regarding race and ethnicity, 41% of the undergraduate nursing students are from minority populations (28% African American, 11% Hispanic, and 2% Asian). The majority of students are age 23 and older and are enrolled full time in the university while working part time outside of school. Most students live off campus.

All students enrolled in the adult medical-surgical nursing course taken in either the second semester of the junior year or the first semester of the senior year were invited to participate. The majority of students had never completed a concept map prior to this course.

Instruments

Participants completed two instruments. The first was the Learning Style Survey (LSS), an adaptation of Kolb's (1976) Learning Style Inventory (LSI). The LSS consists of nine sets of statements, each of which is ranked by the respondent on a scale of 4 to 1, according to the degree to which the statement describes characteristics of the respondent. Like the LSI, the LSS yields three kinds of scores. The first set consists of four subscale scores, which are descriptive of the respondent's preferences for *concrete experience* (CE), *active experimentation* (AE), *abstract conceptualization* (AC), and *reflective observation* (RO) modes of learning. The subscale scores are used to calculate the second set of scores, which describe the respondent's propensities for apprehending new knowledge (the *grasping* score) and integrating it into existing cognitive structures (the *transforming* score). Finally, the grasping and transforming scores are plotted on a grid, which identifies the respondents' preferred learning style: concrete, active, abstract, or reflective.

The LSI has been used extensively as a means to identify learning preferences in a variety of learner groups, including students of the health professions (Campeau,

TABLE 1

Learning Style Survey Subscale Scores (n = 120)

Subscale	Possible Range	Mean (*SD*)
Concrete experience	8 to 21	14.42 (2.60)
Active experimentation	7 to 23	17.33 (3.09)
Abstract conceptualization	8 to 21	13.23 (2.80)
Reflective observation	8 to 23	15.10 (3.58)

1998; Coker, 2000; Freeman & Tijerina, 2000). Kolb (1985) and others (Geiger & Pinto, 1991) reported satisfactory internal consistency of the four subscale scores and the two calculated scores. However, test-retest reliability of the LSI has been variable, reflecting the theoretical proposition that learners can adapt learning preferences and modes according to the learning context (e.g., subject, environment) (Kolb, 1976).

No literature could be found regarding the reliability and validity of the LSS in previous research. In this study, internal consistency reliability of the subscale scores of the LSS was low, with Cronbach's alpha coefficients as follows: 0.42 for AE, 0.39 for AC, 0.47 for RO, and 0.00 for CE (n = 180). Test-retest reliability data were obtained from 13 students. Overall learning style was the same for 8 of the 13 students (62%) on the retest, and correlations between the subscale scores on test and retest were moderately strong (0.59 to 0.77) and statistically significant ($p < 0.05$) for the CE, AE, and AC subscales.

Validity of the LSS was supported by negative correlations between the AC and CE subscales ($r = –0.26$, $p < 0.01$), which indicate the grasping dimension, and between the AE and RO subscales ($r = –0.50$, $p < 0.01$), which indicate the transforming dimension. Negative correlations would be predicted between abstract versus concrete and between active versus reflective modes.

The second instrument was developed by the researchers and consisted of nine open-ended questions related to preferences for creating concept maps. Demographic data were also collected on this instrument.

Data Collection

Data collection began after institutional review board approval was obtained. Students received written and verbal explanations of the study. It was emphasized that participation was voluntary and that participation or nonparticipation would not affect the student's course or assignment grade. Students were assured of confidentiality of all information provided.

Completion of each instrument took approximately 10 minutes. The instruments were completed at the beginning of two different class periods three quarters of the way through the semester after the concept map and case study assignments had been completed. To estimate test-retest reliability, the LSS was readministered to 13 students at the end of the semester.

TABLE 2

Concept Map Grades by Learning Preference

Learning Preference	*n*	Concept Map Grade Mean (*SD*)
Active	18	92.83 (6.04)
Abstract	19	90.32 (6.64)
Reflective	20	88.90 (12.30)
Concrete	22	88.33 (9.78)
Total	79	89.98 (9.15)

Note. Learning preference is calculated from Learning Style Survey subscale scores.

Because the majority of students had not created a concept map prior to this class, students were presented with both written and verbal instructions on concept map development. The purpose of creating concept maps—linking new learning to previous knowledge, organizing thoughts, stimulating critical thinking, and displaying conceptual relationships graphically—was emphasized. In addition, two faculty-created comprehensive concept maps and several student-created concept maps were provided as examples.

Students were required to include the following elements in the concept map:

- Pathophysiology.
- Nursing diagnoses.
- Treatment and interventions.
- Diagnostic tests.
- Clinical manifestations.

Concept maps were evaluated on hierarchy, propositions, cross-links, and thoroughness. The grading rubric was adapted from the one advocated by Novak and Gowin (1984). Although a structured grading rubric was used, students were encouraged to approach their concept map development creatively. It was stressed that there were limitless ways to correctly present the required information. As a result, students submitted concept maps reflecting their individuality, ingenuity, and imagination. For example, some maps were created on poster board, some used color to represent categories, some were created using computer programs, whereas others were sketched freehand.

Two nursing faculty co-taught the medical-surgical nursing course in which these assignments were given. In a pilot study, the faculty evenly divided the concept maps between them for grading. Although the faculty strictly adhered to the grading rubric, the interrater reliability was moderately low. Thus, for this study, one faculty member graded all of the concept maps.

Because simply requiring one faculty member to grade all of the concept maps would not fully address the inter-

rater reliability issue, other measures were adopted as well. A structured approach to grading the maps was used. First, maps were grouped into categories by disease state. Then, a preliminary review of each group was completed, resulting in a rough sorting of maps itemized from *best* to *least favorable*. The maps were graded in order, according to the preliminary sorting, allowing the best maps to be graded first, thus providing an informal standard within the class. Although several mechanisms were used to minimize subjectivity, we acknowledge that some degree of subjectivity in grading will always be present due to the nature of the assignment.

TABLE 3

Preference for Concept Maps or Case Studies by Learning Preference

Learning Preference	Prefer Concept Maps	Prefer Case Studies	No Preference	Total
Abstract	11	6	1	18
Concrete	9	8	0	17
Active	7	7	4	18
Reflective	4	7	2	13
Total	31	28	7	66

RESULTS

Quantitative Data

A total of 120 students completed the LSS. Mean scores for the four subscales of the LSS are shown in **Table 1.** The mean score for the AE subscale was 17.33 (SD = 3.09) and was significantly higher ($p < 0.001$) than the means for the other three subscales. Subscale scores were used to calculate the overall learning preferences of the students, of which 29% (n = 35) were classified as concrete, 26% (n = 31) reflective, 23% (n = 28) abstract, and 22% (n = 26) as active.

Concept map grades and final course grades were available for 79 students, with the mean concept map grade being 89.98 (SD = 9.15). The mean final grade for the course was 82.68 (SD = 7.04). Concept map and final course grades were weakly correlated (r = 0.37, $p < 0.01$). Mean concept map grades for students by learning preference are shown in **Table 2.**

One-way ANOVA was used to examine the influence of learning preference on concept map grades. Although students in the active group had higher mean concept map grades than did students with other learning preferences, the difference was not significantly higher [F (3, 75) = 0.921, p = 0.435].

Students were asked on the survey whether they preferred concept maps or case studies, another learning strategy used in this course. Results according to learning preference are shown in **Table 3.** Nearly twice as many students in the abstract learning preference group preferred concept maps to case studies. No distinct preferences were found for the other three learning preference groups.

Qualitative Data

The author-developed survey asked four open-ended questions regarding both the case study and concept mapping learning strategies. Students were asked whether they had a preference for concept maps or case studies and whether they found them to be effective learning strategies. Only findings related to concept maps are reported in this article.

Initially, each member of the research team examined the responses to each question for positive or negative answers and comments. The research team, which consisting of three doctorally prepared faculty and one graduate student, then met to share their impressions and identify appropriate codes. Ten codes emerged, and comments were then coded using ATLAS.ti version 4.0 software. The research team then identified two major categories of codes, each encompassing both positive and negative aspects of the category.

The first major category was labeled *impact on learning* and included five codes that described comments about the usefulness of concept mapping to the student's learning, such as "comprehensive," "critical thinking," "organized," "not relevant," and "does not fit learning style." The second category was labeled *process of doing* and reflected codes that described comments about the mechanics of concept mapping, such as "forces me to research," "creative," "burdensome," "inconsistent," and "confusing."

Responses to the survey questions were then examined in relation to learning preference categories. Overall, no relationship was found between learning preference and survey comments. See **Tables 4 and 5** for examples of categories and codes.

DISCUSSION

In today's education environment, one of the key responsibilities of nursing faculty is to identify learning strategies that promote critical thinking and integration of knowledge from a variety of disciplines. The use of concept mapping to accomplish these goals was examined in this study in relation to student learning preferences and performance.

The findings of this study indicate that learning style preference does not play a role in students' ability to perform well on concept maps. Research reported in the literature supports these results. Freeman and Tijerina

TABLE 4

Qualitative Results: Impact on Learning

Code	Examples
Comprehensive	• "Helped me understand the topic in more depth."
	• "Able to see the big picture."
	• "Examined all aspects of the subject."
Critical thinking	• "Made you think about the system you were studying."
	• "I created it, so it made sense to me."
	• "It forced me to rationalize why and how a concept was to be linked."
Organized	• "Helped me organize my thoughts."
	• "Made me think about how to set up ideas in a more organized way."
Not relevant	• "Waste of my time."
	• "Did not help me at all as far as testing and learning the material."
Does not fit learning style	• "I'm not very artistic."
	• "Don't feel that a drawing of a map helped me."

TABLE 5

Qualitative Results: Process of Doing

Code	Examples
Forces me to research	• "Made me put more into studying."
	• "What I didn't get in class I might get in the concept map."
Creative	• "A very creative way to organize material."
	• "Provided a new way of learning."
Burdensome	• "Waste of time; cut down on my study time."
	• "Too time consuming and lost my interest."
Inconsistent	• "Don't know how much information to put on a concept map that will make it good enough to get a good grade."
	• "Grading is extremely inconsistent."
Confusing	• "I know the material and can organize it well, but the lines on the map screw everything up for me."
	• "It is incredibly messy and looks disorganized."
	• "If you're not the one making it, I don't think it would be a helpful tool."

(2000) found no relationship between physician assistant students' learning style and the method of delivery on outcomes. Ramprogus (1988), studying nursing students, found no relationship between learning styles and learning effectiveness. These findings suggest that concept mapping is an appropriate teaching strategy for students of all learning style categories.

This study found that the learning style preference of the nursing students sampled was closely divided among the four categories identified by Kolb (1976). The nursing students sampled in Ramprogus' (1988) study also failed to demonstrate a dominant learning style preference. In a meta-analysis of business students, Loo (2002) also found a variability of learning styles among business majors. Because no single learning style appears to prevail among students of like majors, a variety of teaching strategies should be used to meet the needs of all students.

Although some students in this study expressed negative feelings about the use of concept mapping as a teaching approach, their discomfort with completing this assignment did not seriously hamper their success in the course. The qualitative data presents evidence to suggest that this teaching strategy may have actually challenged students to use a new, unfamiliar, and uncomfortable approach, thus expanding their repertoire of learning strategies. Although requiring assignments that meet the comfort level of students can motivate learning and enhance participation, they can also suppress the development of other potentially effective methods of learning (Sadler-Smith, 1996).

LIMITATIONS

The major limitation of this study is the questionable reliability and validity of the tool used to measure learning preference (the LSS). As noted above, issues related to subjectivity in grading concept maps may have contributed to the large standard deviations. In addition, a small sample was a limiting factor in this study, as was the limited population used, which limits the generalizability of the findings.

IMPLICATIONS AND RECOMMENDATIONS

The findings of this study support the conclusion that a complex learning strategy, such as concept mapping, can be effective for students with all kinds of learning style

preferences. However, to advance the study of the relationships between learning style preference and teaching strategies, further development and validation of the instruments used to measure learning style preferences are needed. Many such tools are available, but most do not have well-substantiated reliability and validity. Researchers may want to consider using multiple instruments to measure the same construct in an effort to more fully substantiate validity.

Although the findings of this study indicated no relationship between learning style preference and aptitude for creating concept maps, it may be beneficial to examine whether particular strategies, such as concept maps, are more effectively used as teaching tools, rather than as graded assignments. There is evidence that "forcing" students to use strategies that are not consistent with their learning style preferences can be beneficial to increase students' repertoire of problem solving skills. It may also be useful to examine the influence of learning style preference on the development of critical thinking skills, and vice versa, especially over the course of the nursing curriculum. Such investigation could provide insight into the ways nurse educators can tap into students' learning style preferences to facilitate the development of critical thinking and problem solving skills.

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