

# ▲ Learning Styles of Allied Health Students Using Kolb's LSI-IIa

*Patrick Hauer, PT, EdD, MHS  
Christina Straub, PT, MS  
Steven Wolf, PT, MS*

The purpose of this study was to assess the learning style preferences of students enrolled in various allied health professional programs. Five professions were examined: nursing, physician assistant (PA), occupational therapy (OT), physical therapy (PT), and speech-language pathology (SLP). The assessment instrument used was the Kolb Learning Style Inventory LSI-IIa. The study included 89 subjects from the various allied health care programs enrolled at a small midwestern university. Findings indicated similar learning style preferences between nursing, OT, PA, and SLP student groups. Students from these groups exhibited a close balance between all four learning styles. The nursing and SLP groups showed a slight preference for concrete experimentation, whereas the OT and PA groups preferred abstract conceptualization. The learning style of the PT students was that of converger, with a strong tendency toward active experimentation versus reflective observation. An emphasis needs to be placed on student learning styles and its impact in the educational process. An understanding and incorporation of learning styles in the education of health care providers could have a positive impact not only on the teaching and learning process but also on the effectiveness of interdisciplinary team interactions and the patient educational process. *J Allied Health* 2005; 34:177-182.

---

STUDENTS have preferred methods of learning information, and these methods of responding to and using stimuli in the context of learning are referred to as learning styles. James and Gardner defined learning styles as the manner in which learners most efficiently and effectively perceive, process, store, and recall material they learn.<sup>1</sup> Montgomery and Groat conducted a study at the Center for Research on Learning and Teaching at the University of Michigan.<sup>2</sup> The results of the study suggest various reasons why learning styles should be considered in the teaching process. First, an

---

**Dr. Hauer** is Assistant Professor and Ms. Straub and **Mr. Wolf** are physical therapy students, Department of Physical Therapy, University of South Dakota, Vermillion, South Dakota.

Received January 7, 2003; revision accepted April 14, 2004.

Address correspondence and reprint requests to: Patrick Hauer, PT, EdD, MHS, Department of Physical Therapy, Division of Health Sciences, University of South Dakota, 414 East Clark Street, Vermillion, SD 57069. Tel 605-677-6504; e-mail phauer@usd.edu.

understanding of learning styles can facilitate a greater dialogue between the teaching and the learning process.<sup>2</sup> An assumption of many current teaching practices is that students are "empty vessels" and that the role of the teacher is to fill them with knowledge.<sup>3</sup> However, the research suggests that dialogue is more appropriate and that it emphasizes "the interactive, cooperative, relational aspects of teaching and learning."<sup>2</sup>

Secondly, knowledge of students' learning styles can help an instructor respond to a more diverse student body. The student population continues to increase in diversity, and this diversity can affect classroom settings in many ways.<sup>2</sup> The third reason for understanding learning styles is to allow faculty to communicate their message in the most efficient way.<sup>2</sup> Despite good intentions, faculty members may be so concerned with covering the subject matter that they forget how much of the material really is conveyed. For example, in a typical 50-minute lecture class, students retain 70% of what is conveyed in the first 10 minutes but only 20% for the last 10 minutes.<sup>4</sup> If teachers really want to get their message across, they need to orchestrate the material in a multifaceted way across the range of student learning styles.<sup>2</sup> The fourth reason is to make teaching more rewarding. If teachers are not inclined to self-reflect about their teaching practices, they are likely to continue to teach their students in the way they themselves learn best. By making an effort to match teaching style with learning style, teachers may be able to reap greater satisfaction from teaching.<sup>2</sup> The final reason to incorporate learning styles into the classroom is to ensure the future of our disciplines. An undisputed assumption in career counseling is that an individual will be better suited to some tasks, subject areas, and careers than others.<sup>2</sup> By teaching to various learning styles, thus welcoming and encouraging these atypical students, teachers may be ensuring the long-term viability of their given field.

There have been numerous studies assessing the learning styles of students in various health-related disciplines.<sup>5-9</sup> Findings from these studies are mixed regarding a preferred learning style for each discipline. Many of the studies have focused on individuals in the nursing profession.<sup>5</sup>

Several different learning style inventories have been used to assess students' preferred methods of learning. A few of these assessment tools include Three Representational Modes (TRiM), VAK (Visual, Auditory, Kinesthetic),

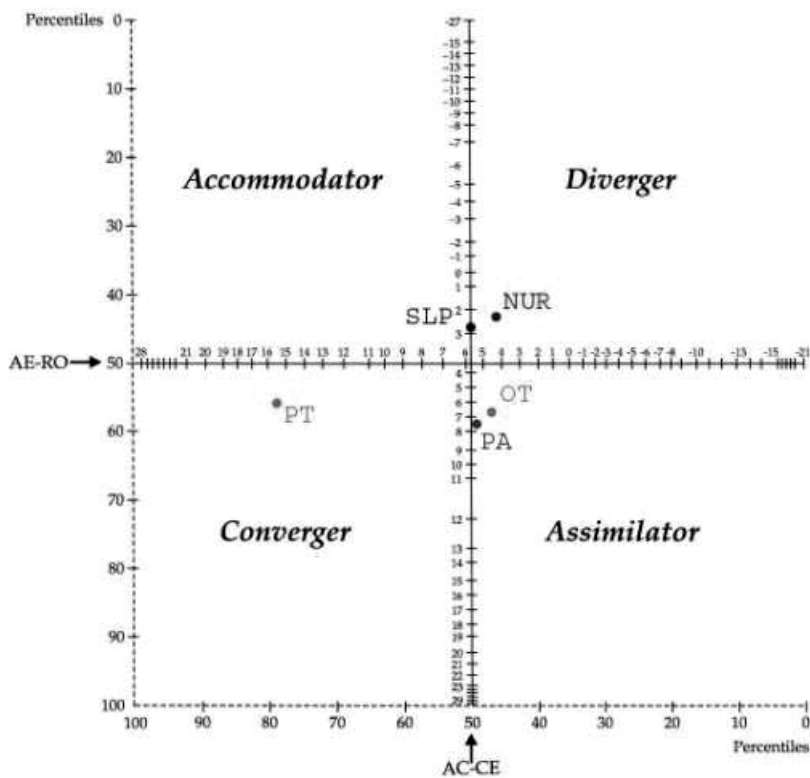


FIGURE 1. Kolb's Learning Style Grid.

Kolb's Learning Style Inventory, and Howard Gardner's Multiple Intelligences.<sup>10</sup>

Kolb's Learning Style Inventory has become the most frequently used method for assessing learning styles of allied health professionals.<sup>6</sup> Kolb's Learning Style Inventory is based on John Dewey's emphasis on the need for learning to be grounded in experience, Kurt Lewin's work stressing the importance of a person being active in learning, and John Piaget's theory of intelligence resulting from the interaction of the person and the environment.<sup>10</sup>

Kolb's four-stage theory is based on a model with two dimensions. These two dimensions are expressed in the form of a Learning Style Grid developed by Kolb (Figure 1). The first dimension (x-axis) is based on an individual's preferred way of learning a task. The left end of this dimension identifies a preference for doing tasks, whereas the right end indicates a preference for watching a task. The second dimension (y-axis) is based on an individual's thought and emotional processes. The top end of this dimension indicates that an individual prefers to learn through his or her feelings, whereas the bottom indicates a preferred learning process based on thinking. The horizontal dimension can also be thought of as representing an individual's reaction to his or her environment, whereas the vertical dimension represents his or her preference for logic or emotion.<sup>11</sup>

Kolb envisioned learning as a four-stage process requiring different kinds of abilities. These abilities include con-

crete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). CE emphasizes involvement with people in everyday situations. The individual tends to rely on feelings and to be open minded and adaptable to change. In RO, people understand different points of view but may not take action. A person relies on his or her own thoughts and feelings in forming opinions. AC involves using logic and ideas to understand problems or situations. Systematic planning and development of theories and ideas are used to solve problems. The AE stage depends on experimenting with changing situations and finding a practical approach.<sup>11</sup>

An individual's learning style results from a combination of the four basic learning abilities or modes and corresponds to one of the four quadrants from Kolb's Learning Style Grid. The four learning style types are converger, diverger, assimilator, and accommodator. The converger learning style combines AC with AE. People with this learning style are best at finding practical uses for ideas and theories. Strengths include problem solving, decision making, deductive reasoning, and the ability to define problems. Convergents often spend too much time solving the wrong problem or make hasty decisions.<sup>11</sup>

The diverger is a combination of CE and RO. People with this learning style are best at viewing concrete situations from many different points of view. Observation is preferred over action.<sup>11</sup>

The assimilator learning style combines AC with RO. People with this learning style are best at understanding a wide range of information and putting it into a concise, logical form. Assimilators are interested in abstract ideas and concepts. The logical soundness of a theory is more important than its practical value.<sup>11</sup>

CE and AE combine to form the accommodator learning style. People with this learning style prefer to learn primarily from "hands-on" experience. Accommodators enjoy carrying out plans and getting involved in new and challenging experiences. These individuals are great at getting things done, leadership, and risk taking.<sup>11</sup>

Sims et al. tested 438 graduate and undergraduate business students using Kolb's LSI-IIa. They found that the internal reliability of the Kolb's subscales ranged from 0.76 and 0.85 and test-retest indices from 0.24 to 0.66.<sup>12</sup> Likewise, Katz and Heimann determined Kolb's LSI to be acceptably reliable and valid.<sup>13</sup>

Harb et al. suggested two reasons for applying the Kolb model to education. They suggested that educators teach to each of the learning styles to reach all of the students. They also viewed the model as a framework for students' lifelong learning process.<sup>14</sup>

The learning styles of 192 registered general nursing/Diploma of Higher Education students were determined using Kolb's Learning Style Inventory before the students had any contact with the lecturing staff. The percentage of students having a predominantly concrete learning style was 53.7%, while 46.3% were predominantly reflective.  $\chi^2$  tests were used to determine if the respondent's learning style varied with age, gender, or having been in employment before becoming a nursing student; no statistically significant associations were found.<sup>5</sup>

DeCoux reviewed the application of Kolb's Learning Style Inventory in the examination of learning styles among nursing students, as reported in the current literature.<sup>6</sup> In general, a lack of significant relationships between learning style and other variables was shown in the research on nursing students.<sup>6</sup> Nursing students were scattered among all four learning style categories. Little agreement occurred as to whether diverger, accommodator, or assimilator learning styles were the most common among nursing students.<sup>6</sup> The converger learning style was rare among nursing students.<sup>6</sup>

A study performed by Linares attempted to determine if students and faculty in nursing and allied health demonstrate a dominant learning style.<sup>7</sup> The study also attempted to correlate an association between a specific learning style and self-directed learning readiness for these groups, if these learning characteristics could predict academic success, and if a discipline-specific learning style could be identified.<sup>7</sup> The study found no significant differences in learning styles between students and faculty, and the converger style was the predominant learning style for all subjects.<sup>7</sup>

A total of 191 physical therapists with at least one year of experience and 121 physical therapy (PT) students from four entry-level master's programs participated in a study

by Bowman et al.<sup>8</sup> The results indicated that PT students preferred the converger learning style, while the clinicians had no significant learning style preference. Male subjects preferred the converger learning style, while female students preferred the assimilator learning style.<sup>8</sup> Bowman et al. concluded that a relationship exists between the environment and learning styles and between gender and learning styles in PT.<sup>8</sup>

Katz et al. also performed a study to examine learning style preferences in PT students.<sup>9</sup> Approximately 74.3% of the students were abstract learners, 45.7% were assimilators, and 28.6% were convergers; no significant gender- or age-related differences were identified by Kolb's LSI-IIa.<sup>9</sup>

The purpose of this study was to determine whether a difference exists in the learning styles of students enrolled in various allied health programs. The learning styles of students enrolled at a small midwestern university in the nursing, physician assistant (PA), occupational therapy (OT), PT, and speech-language pathology (SLP) programs were assessed.

## Methods

### RESEARCH DESIGN

A nonexperimental study using a sample of convenience was used to compare the learning styles of students enrolled in various allied health programs at a small midwestern university. Approval from the human subjects institutional review board was obtained before the start of the project. The study was based on the following null hypothesis: no difference in learning styles exists between groups of students from the various allied health disciplines.

### SUBJECTS

Participants were current students enrolled in one of the allied health programs at a small midwestern university. The allied health programs included nursing, OT, PA, PT, and SLP. The programs varied in regard to the type of degree conferred, preparatory educational requirements necessary for admission into the program, and the maximum number each program could accept for enrollment. The nursing program awards an associate of arts degree and requires a high school degree. The PA program is a certificate in PA studies and requires a high school degree and specific college courses. The OT, PT, and SLP programs are master's level and require an undergraduate college degree as well as completion of specified college courses.

Permission was gained from the chairperson of each program to administer the survey during a regularly scheduled class. Participants were given a brief overview of the project and asked to participate on a voluntary basis. Each group of participants was given informed consent documents to read and sign if they elected to participate. Clear and concise instructions regarding the inventory were read to each group before their completion of Kolb's LSI-IIa.

TABLE 1. Means and SDs of Kolb's Learning Style Modes

Profession	No.	CE	RO	AC	AE
Nursing	32	25.7 (7.2)	31.1 (7.5)	28.0 (5.5)	35.2 (6.8)
PA	16	23.3 (7.6)	30.0 (6.6)	31.2 (8.7)	35.6 (6.8)
OT	12	24.9 (8.6)	30.3 (9.1)	31.8 (8.9)	35.0 (4.9)
PT	17	22.5 (3.7)	22.5 (3.7)	28.5 (5.8)	38.2 (3.7)
SLP	12	23.6 (4.1)	32.1 (6.6)	26.3 (6.8)	37.9 (4.0)

CE, concrete experience; RO, reflective observation; AC, abstract conceptualization; AE, active experimentation, PA, physician assistant; OT, occupational therapy; PT, physical therapy; SLP, speech-language pathology.

The number of participants included 32 nursing students, 16 PA students, 12 OT students, 17 PT students, and 12 SLP students. Group sizes varied due to varied enrollment numbers for each program.

#### INSTRUMENTATION

Kolb's LSI-IIa was used to assess the learning mode and style of each group of students from the allied health programs. Permission to use the instrument was obtained from McBer & Company (Boston, MA). Kolb's LSI-IIa requires the individual to numerically rank each of four responses to 12 specific questions regarding the process by which they learn. The value for each response (1–4) is placed into one of four equations. A total for each equation is then derived, which equates to a numerical value for each of the four learning modes: CE, RO, AC, and AE. The value obtained for CE is then subtracted from the value obtained for AC; this yields the y-coordinate. The value derived for RO is subtracted from AE to yield the x-coordinate. The x and y values are then plotted on Kolb's Learning Style Grid, resulting in a preferred learning style.<sup>15</sup>

#### Results

Kolb's LSI-IIa was administered to 89 allied health students. Table 1 includes the mean score and SDs of each discipline for each of the modes upon which Kolb's Learning Style Inventory is based. Mean scores for nursing students were highest in the areas of AE (35.2) and RO (31.1). PA students scored the highest in the areas of AE (35.6) and AC (31.2). Results from the OT students indicated a preference for AE (35.0) followed by AC (31.8). AE (38.2) followed by AC (28.5) were the modes with the highest mean scores for PT students. SLP students were highest in AE (37.9) followed by RO (32.1).

Group mean scores for AC and CE were subtracted to obtain a y-axis coordinate; scores for AE and RO were used

to obtain the x-axis coordinate (Table 2). Figure 2 illustrates a graphical representation of the AC – CE mean values for each group, and Figure 3 depicts the AE – RO mean values. The resulting x and y coordinates were then transposed onto Kolb's Learning Style Grid to determine the preferred learning styles of each of the disciplines (Figure 1). The preferred learning style for the nursing students was that of diverger. SLP students were on the line between accommodator and diverger. The preferred learning style for PT students was converger, whereas OT students were assimilators. PA students fell on the line between converger and assimilator.

#### DATA ANALYSIS

A one-way analysis of variance was performed on the AC – CE and AE – RO values to determine if a statistically significant difference existed between the groups ( $\alpha = 0.05$ ). The AC – CE between-groups *p* value was 0.672, whereas the AE – RO *p* value was 0.003. A least squares difference post hoc analysis of the AE – RO values indicated significant differences between the PT group and all other groups: nursing ( $p = 0.000$ ), OT ( $p = 0.004$ ), PA ( $p = 0.003$ ), and SLP ( $p = 0.005$ ) student groups ( $\alpha = 0.005$ ).

TABLE 2. Mean Combination Scores of Kolb's Learning Style Modes

Profession	AC – CE	AE – RO
Nursing	2.3	4.4
PA	7.9	5.6
OT	6.9	4.7
PT	6.0	15.7
SLP	2.7	5.8

AC, abstract conceptualization; CE, concrete experience; AE, active experimentation, RO, reflective observation; PA, physician assistant; OT, occupational therapy; PT, physical therapy; SLP, speech-language pathology.

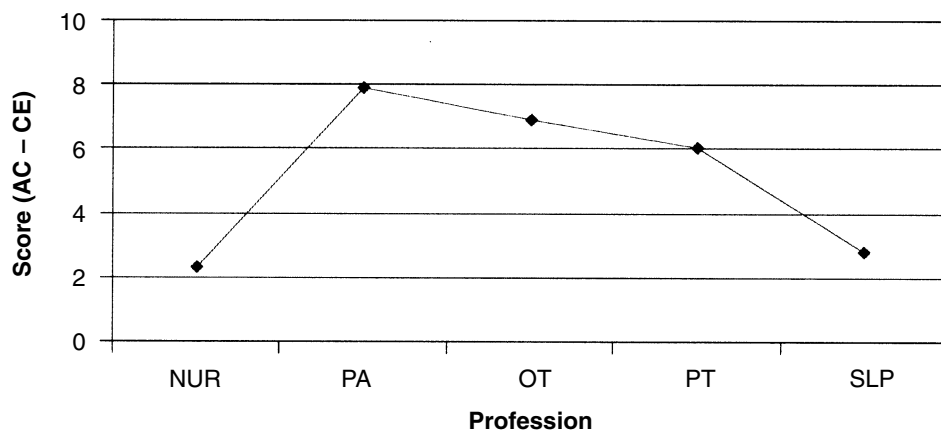


FIGURE 2. Mean AC - CE score. The graph shows the average score for the Abstract Conceptualization (AC) mode minus the average Concrete Experimentation (CE) mode for each of the five professions.

## Discussion

Kolb's Learning Style Grid gives a good two-dimensional view of an individual's learning style. The further an individual's score is from the intersection of the two axes, the more that individual prefers that particular learning style and the less apt they are to use any of the other three styles. Results from this study suggest a close relationship in learning style among the nursing, OT, PA, and SLP students who participated in this study. The coordinates depicting learning style preference for these four groups of students fall close to the intersection of the x- and y-axes. This suggests that these students have the ability to use and fluctuate easily between the four different learning styles during learning. Findings suggest a near-equal relationship between the use of AC with CE for each of the disciplines examined and AE with RO for four of the five groups (with the exception of PT students).

Accommodators learn best from hands-on experience and adapt well to new and challenging experiences. Individuals in the diverger category prefer observation rather than action and are able to view concrete situations from multiple perspectives. Assimilators exhibit a greater interest in abstract ideas and concepts; they have the ability to comprehend a wide range of information regarding a topic and are able to put it into concise, understandable terms. Individuals who utilize the converger learning style are best at putting ideas and theories into practical uses as well as solving problems and making decisions.

As stated earlier, the learning style preference of four of the five groups lies very close to the intersection of the two axes; this makes assignment of a preferred learning style difficult for these groups. The learning style of PA and OT students lies between the converger and assimilator styles, with AC common between the two styles. Students in the SLP and nursing groups exhibit a learning style divided between accommodator and diverger, with a preference for CE. The learning style of PT students lies between the

accommodator and converger styles, with an increased decency toward converger. The mode of learning shared by these two styles is AE.

The nursing students participating in this study were identified as having a learning style preference between that of a diverger and an assimilator, with a slight preference for RO. King,<sup>16</sup> as well as Katz and Heimann,<sup>13</sup> identified a preference for the diverger and accommodator learning styles. Huch found a preference for the accommodator learning style in nursing students.<sup>17</sup> Participants surveyed by Linares<sup>7</sup> had a preference for the converger style, while Cavanagh et al.<sup>5</sup> identified the diverger learning style as predominant in nursing students.

In our study, OT students exhibited a preference between the diverger and the assimilator learning styles. This is in contrast to the study by Katz and Heimann, who found a strong accommodative tendency among OT students.<sup>13</sup> Katz and Heimann also found a preference for the converger learning style by PT students, with a greater tendency toward the AC mode.<sup>13</sup> Wessel et al. found an equal preference for the assimilator and converger learning styles.<sup>18</sup> The PT students in our study demonstrated a preference for the converger style, with more of an emphasis on the AE mode.

A limitation to this study is the small sample sizes of the groups, as well as drawing the samples from only one institution. This makes the generalizing of results inappropriate to specific disciplines as a whole. Given the study by Bowman et al., gender and age of the participants needs to be assessed and correlated to the learning styles of the participants.<sup>8</sup> Differences in these variables could have a significant impact on the outcomes.

## Conclusions

Given the disparity in the results of previous studies, coupled with the findings from this study, it is obvious that additional research is necessary. Research should include studies that identify the most applicable instrument to use

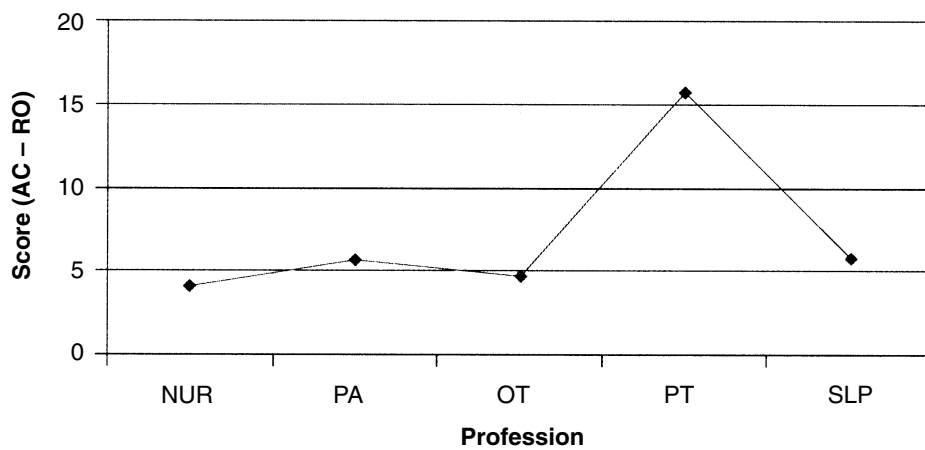


FIGURE 3. Mean of AE - RO. The average score for the Active Experimentation (AE) mode minus the average Reflective Observation (RO) mode is shown for each of the five professions.

for a specific discipline. Limitations of this study include the use of small sample sizes, as well as drawing the samples from only one institution. This makes the generalizing of results inappropriate to specific disciplines as a whole. In addition, given the findings from previous research, gender and age of the participants should be considered and correlated to the learning styles of the participants.<sup>8</sup> Differences in these variables could have a significant impact on the outcomes. The learning style of students needs to be assessed during various stages of their professional education: does it stay consistent, or does it change?

An emphasis needs to be placed on student learning styles and its impact on the educational process. An understanding and incorporation of learning styles in the education of health care providers could have a positive impact not only on the teaching and learning process but also on the effectiveness of interdisciplinary team interactions and the patient educational process.

## REFERENCES

1. James WB, Gardner DL: *Learning Styles: Implications for Distance Learning*. East Lansing, MI: National Center for Research on Teacher Learning; 1995. Eric Document Reproduction Service No. ED514 356.
2. Montgomery S, Groat L: *Student Learning Styles and Their Implications for Teaching*. Center for Research on Learning and Teaching. Available at: <http://www.crit.umich.edu/occ10.html>. Accessed April 15, 2002.
3. Tiberius R: Metaphors underlying the improvement of teaching and learning. *Br J Educ Technol* 1986; 17:144-156.
4. McKeachie W: *Teaching Tips: A Guidebook for the Beginning College Teacher*. 9th ed. Lexington, MA: Heath; 1994.
5. Cavanagh S, Hogan K, Ramgopal T: The assessment of student nurse learning styles using the Kolb Learning Styles Inventory. *Nurse Educ Today* 1995; 15:177-183.
6. DeCoux V: Kolb's learning style inventory: a review of its applications in nursing research. *J Nurs Educ* 1990; 29:202-207.
7. Linares A: Learning styles of students and faculty in selected health care professions. *J Nurs Educ* 1999; 38:407-414.
8. Bowman K, Delargy L, Deshong L, et al: Learning styles of physical therapy students and clinicians. *Phys Ther* 2000; 80:S7.
9. Katz J, Miller J, Balogun J: Learning-style preferences of physical therapist students. *Phys Ther* 2000; 80:S39.
10. Clark D: Learning styles or, how we go from the unknown to the known. ISD Development. May 2000. Available at: <http://www.nwlink.com/~donclark/hrd/vak.html>. Accessed February 22, 2002.
11. Kolb DA: *Learning Style Inventory: Technical Manual*. Boston, MA: McBer & Company; 1985.
12. Sims RR, Veres JG, Watson P, et al: The reliability and classification stability of the Learning Style Inventory. *Ed Psy Meas* 1986; 46:753-760.
13. Katz N, Heimann N: Learning styles of students and practitioners in five health professions. *Occup Ther J Res* 1991; 11:238-244.
14. Harb JH, Durrant SO, Terry RE: Use of the Kolb Learning Cycle and the 4MAT system in engineering education. *Education* 1993; 82:70-77.
15. Kolb DA: *Learning Style Inventory*. Boston, MA: McBer & Company; 1993.
16. King JE: A comparative study of adult developmental patterns of generic students and RN students in a baccalaureate nursing program and the correlation of impact of the educational experiences on the developmental patterns [dissertation]. Nashville, TN: Vanderbilt University; 1984.
17. Huch M: Adult students' locus of control, learning styles and satisfaction with the baccalaureate nursing program [dissertation]. Oxford, MS: University of Mississippi; 1981.
18. Wessel J, Loomis J, Rennie S, et al: Learning styles and perceived problem-solving ability of students in a baccalaureate physiotherapy programme. *Physiother Pract* 1999; 15:17-24.