It is critical thinking that enables the registered nurse to solve problems in order to provide safe and effective care to the client. How does the nurse learn critical thinking skills required for the practice of nursing? It is in nursing education that the student, guided by the faculty, develops critical thinking skills. By using methods that encourage critical thinking such as case studies, client presentations, and high-level testing, faculty help the student learn to think critically. One does not usually think of testing as a method for teaching critical thinking. It has been found that writing test questions involving mastery of content and high-quality problem solving does measure and promote the use of critical thinking skills. Nursing education programs that use high-level multiple-choice questions prepare the student to think critically and to be better prepared for the National Council Licensure Examination (NCLEX). To help faculty develop critical thinking questions, an instrument is needed that measures the quality of the questions and tests. Computer database software programs are tools that can help improve test development, promote critical thinking, and better prepare the student for the NCLEX.

**PURPOSE**

Morrison et al comment that a high level of discrimination is required in high-level multiple-choice questions. The NCLEX uses critical thinking multiple-choice items to determine whether the graduate is capable of providing safe effective care to the client or not. Two of the University of Cincinnati Raymond Walters College (UCRWC) Associated Degree Nursing Program Outcomes are that the graduates of the program will use critical thinking skills and be successful on the NCLEX. The NCLEX pass rate is a criterion used for state approval and accreditation for nursing education programs. Low pass rates can reflect on the nursing education program and the college. For this reason, NCLEX success is a priority for nursing education programs. It is imperative that nursing education programs devote money, time, and energy to improving the nursing student’s critical thinking and develop better
Reliability refers to how consistent the test scores would be if a person took the same test more than once. A reliable test, then, reflects the consistency of the test. Valid and reliable multiple-choice tests provide an excellent measurement of the student’s knowledge, critical thinking skills, and readiness to sit for the licensing exam.

By examining test statistics, curriculum and program outcomes can be measured. Without a structured testing instrument to assess the student’s learning, nursing education cannot assess the educational outcomes and be assured of the student’s ability to practice safe and effective nursing care. For this reason, nursing education needs to devote measurable time to creating tests that measure not only knowledge, but also critical thinking skills.

For this to happen, nursing education must use principles of test construction and item analysis. A systematic and structured program for storing, creating, and analyzing test items is necessary. A computer database program can give easy access to an item analysis of questions to pinpoint problems with test questions and students’ critical thinking skills. There are computer database scoring and analysis software programs that give faculty the necessary instruments to support the development of high-level questions and contribute to the evaluation of critical thinking and nursing education.

HISTORY

In 1998, UCRWC had no available computer database service on campus that supported test development, storage banks, or data analysis. The UCRWC nursing department was advised by consultants in the field of computerized testing and nursing program curriculum evaluation to acquire a system that would better evaluate the course objectives through testing. The nursing department identified the need to secure a computer database software program for testing and evaluation purposes. The nursing department wanted a scientific method that would better meet their goals of evaluating the student’s knowledge and critical thinking skills and improving NCLEX results.

A proposal was presented to the Dean for a computer database software program for testing and evaluation for the college. The proposal included a request for Scantron’s ParSYSTEM (Irvine, CA) computer software database system, as recommended by Morrison et al. It was considered imperative that evaluation of nursing students’ ability to use critical thinking skills be determined satisfactorily and that they be prepared to complete the NCLEX successfully.

The ParSYSTEM offered an excellent instrument to help the nursing department achieve this because it provides programs that store test questions and tests, categorizes test questions, scores tests, and provides item analysis. According to Morrison et al, ParSYSTEM simplifies the complex process of testing and is becoming a standard for nursing schools.

Additional areas taken into consideration in the selection of a computer database testing system was the cost, time consumption, technological support, and resources required for successful implementation. All these points were included in the proposal.
After extensive review, the Dean’s office approved the purchase of Scantron’s ParSYSTEM, which includes the software programs ParSCORE and ParTEST. The ParSCORE program is a “versatile software application that allows you to develop and manage student records and test information which includes statistical analysis of test questions and tests with the ability to interface with ParTEST by transferring statistics to individual questions.” The ParTEST program is a “versatile software application that allows you to create instructions, item banks, objectives, questions, tests and generate reports in addition to creating item banks to function as database repositories where you can store questions.”

The purchase included a scanner, the ScanMark ES 2010 Optical Mark Reader, ParSCORE for Windows, and ParTEST for Windows. The ParTEST software was the LAN version. The time from submission of the proposal to approval of the ParSYSTEM was approximately 1 year. Because it was decided that all faculty could use the same computer for ParSCORE, the college purchased one annual license for ParSCORE. The scanner, a computer, and a printer were placed together in a secure and faculty-accessible room. The college purchased annual licenses for all nursing faculty and the secretary to have ParTEST on their office computers. It was another year before the programs arrived and then were installed on the computers for use.

**COORDINATOR ROLE**

An administrator of the ParSYSTEM was needed to create the accounts in the programs, to maintain security, to educate the faculty and staff, to implement and supervise the program, to troubleshoot, and to be the liaison for the nursing department to the college. I volunteered to be the ParSYSTEM coordinator for the nursing department because I had an interest in computers and test development. My title was ParSCORE/ParTEST Coordinator. As the Coordinator, I am the supervisor, resource person, problem solver, educator, and administrator for the ParSYSTEM for the nursing department.

Initially, there was no additional compensation, but after 1 year, it became apparent that I was contributing much time beyond my regular work hours. After that year, I received overload pay for my work as ParSCORE/ParTEST Coordinator.

The Dean’s office is responsible for service of the ParSYSTEM program. The college networking department is responsible for the installation and maintenance of the ParSCORE and ParTEST software programs. I work closely with these two organizations to ensure functioning of the ParSYSTEM in the nursing department (Figure 1).

As Coordinator, I participated in the online training program provided by Scantron. This was arranged through the college. I found the instruction limited and discovered that the online course provided only cursory knowledge.

At completion of that training, I began self-instruction. In 2000, Scantron invited me to participate in the beta-phase piloting of the Scantron ParSCORE 4.0 LAN software system. As a participant, I completed evaluation forms regularly for Scantron. I found this beneficial. It encouraged me to evaluate my learning and increased my knowledge. The resources that I use as Coordinator are the Scantron service phone line support and the ParSCORE and ParTEST User’s Guides (these user guides are now available online).

**FACULTY EDUCATION**

The nursing faculty wanted to develop item banks with high-level multiple-choice questions that would measure and promote critical thinking skills. My goal was to teach nursing faculty and the secretary the ParSCORE and ParTEST programs so they could accomplish this successfully.

I constructed the method of implementation for faculty instruction during that first year. Initially, I developed ParSCORE and ParTEST instruction handbooks for the faculty. The handbooks were based on...
the ParSCORE and ParTEST User’s Guides, but included only information that the nursing faculty would use. The instruction was simplified and focused on the needs of the courses. Each faculty member received a copy of the handbook. A copy was stored near the Scantron scanner and ParSCORE computer. Each year, I updated the handbook to include additional user information and the newest version software program information. Since the beginning of the nursing department’s implementation of the software programs, Scantron has developed two new versions, which the college has acquired.

ParSCORE IMPLEMENTATION

Because I thought ParSCORE was easier than ParTEST to learn, and because test scoring and analysis was a priority for the faculty, I began teaching ParSCORE first. The UCRWC Nursing Program had six team-taught courses that would be using the ParSYSTEM.

Initially, 14 faculty required training. In the autumn quarter 2001, I met with groups of one to two faculty members at a time and taught them how to use ParSCORE for their courses. For this instruction, I created a training course file. Using the training file, I instructed the faculty how to set up a course, enroll students, grade tests, and print reports. Scheduling the training sessions was difficult because of faculty schedules.

Computer skills were varied among the faculty. Those more familiar with computers learned more quickly. Training sessions lasted 2 to 3 hours. Extra time was spent with faculty that required more education to understand the program. Overall, training went smoothly.

The nursing department faculty began to implement ParSCORE in their courses in the autumn quarter of 2002. I was on call by way of a pager for troubleshooting and training when the faculty had difficulties. I made myself available during course testing times. If problems arose with the computer or printer that I could not solve, I contacted the college’s networking department for help. Problems usually were human error, simply requiring clarification of the program instructions. A phone was available near the scanner and computer for faculty use if they had problems.

ParTEST IMPLEMENTATION

In the autumn quarter of 2002, I decided to implement ParTEST first in the course I was teaching. I believed this would be easier because I knew the course and it had a small teaching team. The ParTEST program required much more planning and organization than the ParSCORE program. I needed to decide how to arrange the course content into the design of the software program.

The ParTEST program is organized into accounts, item banks, and objectives. The test questions are stored under the item banks and the objectives. To understand the system, a file cabinet can be used as an analogy. A file cabinet holds the course accounts. Each file drawer holds one course account. In each drawer are item banks that are the files. The objectives are the folders in the item bank files. It is in the objective folders that the questions are stored (Figure 2).

I used this analogy in my faculty training. First, I made each course a separate account. I then needed to decide how to organize each course’s content in the account so the faculty would find it purposeful and easy to use. The syllabi contained the course content and objectives. Test items needed to come from objectives and content of the course. Based on this, I decided to use the course syllabi for the ParTEST outline. The course syllabi needed to be organized into an outline form using item banks and objectives. Main topics were used from the syllabi as the item banks and subtopics as the objectives. I asked each course team to develop the item bank and objective outline for their course syllabi. This allowed the faculty familiar with the course to choose how they wanted content organized. Each course team submitted an outline in the form of item banks and objectives based on the syllabi and course objectives for the courses they taught. I then entered these item banks and objectives into each course account file (Figure 3).

Test item entry was next. The choice by experts as the most effective type of question and used on the NCLEX is the multiple-choice question. It is the easiest and quickest to grade. The UCRWC Nursing Program uses multiple-choice questions on all their tests. The ParTEST program provides a design that allows the...
user to select the question type, then give the question a
name. The user then enters the stem, answer, dis-
tractors, rationale for the answer, and keywords.

Each question needs to be assigned keywords for iden-
tification and test blueprint purposes. The test blueprint
is the foundation of the test and should be based on the
curriculum construct. Keywords are used to search for a
content question and/or to identify the appropriate ques-
tion for the test blueprint. The ParTEST program has a
tab that allows the administrator/coordinator to insert
keywords that can be used to help search for a question
type or category that fits the test blueprint. The
administrator/coordinator can insert choice keywords
specific to his or her design.

I chose to base the first keyword categories on the
Nursing Process, Bloom's Taxonomy of Educational
Objectives, and the Client Needs from the NCLEX
Test Blueprint as recommended by Morrison et al.

Based on the testing principle that test questions should
come from the curriculum construct, I used the
UCRWC Nursing Program curriculum to determine the
keywords for the next two categories, which were Role of the Nurse and Domain of Nursing. Finally, I
included a content topic word that could be used for a
question search. As an example, if the question topic is about insulin administration, then the content
topic keyword would be “insulin.” Under each keyword
category is a drop-down list for selecting the specific
keyword for that category. An example of this is the
Nursing Process keyword category. The drop-down list
included “assessment,” “analysis,” “planning,” “imple-
mentation,” and “evaluation.” When a question was
entered into ParTEST, the user would identify and
select the keywords from the drop-down list for the
keyword categories appropriate for that question.

I began teaching ParTEST to the faculty in the course
I was teaching. They learned how to enter test ques-
tions and how to create a test. In autumn 2002, the
course faculty began to implement ParTEST. I taught
the nursing department secretary and the remainder of
the faculty one course at a time. I began with the course
that had the least number of faculty on the teaching
team, then worked up to the teams with the largest
number. After teaching the faculty as a team, I helped
them implement ParTEST for the next quarter that it
was taught. By the fall of 2005, all courses were using
ParTEST and ParSCORE successfully.

CONSIDERATIONS

Implementation of ParTEST was challenging. The
ParTEST program had several steps for creating a
question before entering it into the appropriate item
bank and objective. It took faculty time to create a
good question and enter it into ParTEST. Burton et al
notes that good multiple-choice test items are generally
more difficult and time consuming to write than other
types of test items, and coming up with plausible dis-
tractors requires a certain amount of skill. Until faculty
could enter enough new multiple-choice questions to
meet the quantity needed for tests, it was decided that the
secretary would enter the test questions from the previous
tests over the preceding 3 years into ParTEST for the
course. This was a daunting task. Each question needed
to be labeled, titled, and categorized. This had to be done
by the faculty familiar with the questions. I asked the
faculty to volunteer to do this for tests from courses that
they had taught previously. I developed a category form
that the faculty used to include the course account name,
item bank category, objective category, question name,
and keyword categories (Figure 4).

After finishing the category forms, the faculty
forwarded the questions and forms to me. I organized
and submitted the category forms and questions to
the secretary for entry into ParTEST. It was a labor-
intensive job that required extra time and energy from
me, the faculty, and the secretary. Questions were en-
tered in 2002, and then again in 2004. An additional
person was hired to help enter a published test bank of
questions in the summer of 2002. I labeled, titled, and
categorized these questions. More than 1,000 questions
were entered into the course accounts over 2 years. The
ParTEST program can store up to 2,000 questions.

Implementation was slower than I had anticipated.
The larger teams required more time for implementation.
I recommended that the team assign a member to be
in charge of the testing process. I developed step-by-
step instructions to make the process easier. The team
had one person who focused on the tests and then
followed the step-by-step instructions. Each team was
able to individualize the process related to their

FIGURE 3. UCRWC Nursing Program Computer Database Outline.
course’s needs. This helped the team implement it in a smoother fashion. The faculty could submit questions to the secretary for insertion into the course account if they wished. If the faculty chose to do this, they still were responsible for completion of the category form for the question.

Another consideration was that the ParTEST program allowed only one person access to the account at a time. With the large number of courses and faculty teaching, there was great potential that more than one faculty member would want to use the program at the same time. By making each course a separate account instead of putting all the courses into one account, fewer faculty needed access to the same course account at the same time.

At times, more than one faculty member did want to use the same course account. The second user who tried to enter the account would receive a message on the computer screen indicating that another user had access to the account, and that the second user could not enter it. It was arranged that the second user would call the other faculty on the team, as well as the secretary, to identify the first user, then ask when that user would be finished with the account. Although this did not eliminate the problem entirely, it did provide a procedure for the times when several faculty wanted to use a course account at the same time.

The program allows a 20-character field for the question name. I developed a template for the question names. Each question had the same format, and this information was in the faculty instruction handbook. Frequently, the faculty would not use the template because they forgot it or wanted to use their own format. This made organizing and retrieving questions difficult at times. The ParTEST program will not allow the question name to be changed once it is used in a test; instead, the program considers it a new question. Statistics for the original question are then lost.

<table>
<thead>
<tr>
<th>ParTEST QUESTION FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course: H/W AG AC F MH M Quarter: F W S SU Test: 1 2 3 4 5 F</td>
</tr>
<tr>
<td>ID# Name of Question:</td>
</tr>
<tr>
<td>Item Bank Name:</td>
</tr>
<tr>
<td>Objective Name:</td>
</tr>
<tr>
<td>Topic Key Word:</td>
</tr>
<tr>
<td>PARTEST KEYWORDS FOR TEST QUESTIONS</td>
</tr>
<tr>
<td>(Check One Keyword Under Each Category For Every Question Written)</td>
</tr>
<tr>
<td>NURSING PROCESS</td>
</tr>
<tr>
<td>Assessment</td>
</tr>
<tr>
<td>Analysis</td>
</tr>
<tr>
<td>Planning</td>
</tr>
<tr>
<td>Implementation</td>
</tr>
<tr>
<td>Evaluation</td>
</tr>
<tr>
<td>CLIENT NEEDS - NCLEX - RN BLUEPRINT</td>
</tr>
<tr>
<td>Management of Care</td>
</tr>
<tr>
<td>Safety and Infection Control</td>
</tr>
<tr>
<td>Growth and Development</td>
</tr>
<tr>
<td>Prevention and Early Detection</td>
</tr>
<tr>
<td>Coping/Adaptation</td>
</tr>
<tr>
<td>Psychosocial Adaptation</td>
</tr>
<tr>
<td>Basic Care and Comfort</td>
</tr>
<tr>
<td>Pharmacological and Parenteral Therapies</td>
</tr>
<tr>
<td>Reduction of Risk, Potential</td>
</tr>
<tr>
<td>Physiological Adaptation</td>
</tr>
<tr>
<td>COGNITIVE LEVEL - BLOOM’S TAXONOMY</td>
</tr>
<tr>
<td>Knowledge</td>
</tr>
<tr>
<td>Comprehension</td>
</tr>
<tr>
<td>Application</td>
</tr>
<tr>
<td>Analysis</td>
</tr>
<tr>
<td>Synthesis</td>
</tr>
<tr>
<td>Evaluation</td>
</tr>
<tr>
<td>ROLE OF NURSE</td>
</tr>
<tr>
<td>Manager of Care</td>
</tr>
<tr>
<td>Member of Discipline</td>
</tr>
<tr>
<td>Provider of Care</td>
</tr>
<tr>
<td>DOMAIN OF NURSING</td>
</tr>
<tr>
<td>Prevention of Illness</td>
</tr>
<tr>
<td>Promotion of Well Being</td>
</tr>
<tr>
<td>Restoration of Health</td>
</tr>
<tr>
<td>Support Through Dying Process</td>
</tr>
</tbody>
</table>

FIGURE 4. Category Form.
The faculty used the statistical analysis for improving the questions. Each time a question was used, the faculty reviewed it, and if necessary, improved it based on the analysis. The question kept the same name, but was assigned a new number. Because of this, it became a fresh question.

Because it took several years to implement ParTEST, some courses could not take advantage of the program immediately. To allow all the core courses to take advantage of the ParTEST test bank, I copied the questions in ParTEST to hard copies and placed them in binders for each course. Then I organized them into item banks and objectives to match the ParTEST course account. The course teams who had not been taught ParTEST yet used the binders to mark the questions they wanted for a test, then gave them to the secretary for test generation.

The faculty liked using the hard copy binders because they were convenient and simple. As the course accounts grew, the binders grew. With encouragement from me and increased familiarity with the ParTEST program, the faculty stopped using the binders and transitioned to using the computer ParTEST program.

**RECOMMENDATIONS**

Learning a new database test and analysis software program can be difficult, especially if one is not familiar with this type of programming. For ParTEST, I recommend that the coordinator get extensive training to be knowledgeable and comfortable with the program. Enrolling in formal classroom instruction would be beneficial and is offered by Scantron. The course is off-site, and there is a fee. The faculty also may benefit from the initial online course as an introduction to the computer programs before being individually trained by the coordinator.

As ParTEST and ParSCORE Coordinator, I worked 15 to 20 hours a week during the implementation period. If you are the coordinator, ensure that you are compensated for extra work. Some weeks require more hours than others. You must be flexible and on call. Faculty must be educated about the concept of using a database to improve testing and student outcomes. Research supports this and can be used to encourage the faculty to participate and be productive in the implementation of the program. Faculty need education on item writing and must practice writing critical thinking test questions. Information on item analysis is important, and each faculty member should understand how to use it for evaluation.

The UCRWC nursing department had a workshop on item writing at the beginning of the ParSYSTEM implementation, as well as a workshop that reviewed item writing after the ParSYSTEM implementation. Faculty were given a copy. Critical Thinking and Test Item Writing by Morrison et al. The book addressed the use of the computer database programs ParSCORE and ParTEST. It gave instruction on how to develop test questions and how to use data analysis to improve test questions. I found it helpful and a great resource for me and the faculty.

I recommend that additional faculty learn the ParSYSTEM thoroughly and be a backup to the coordinator. I do not have someone who knows it in-depth sufficiently to troubleshoot when I am unavailable or to intervene as ParSYSTEM administrator/coordinator in my absence.

The nursing department was supported by UCRWC for implementation and use of ParSYSTEM. Financial and maintenance support from the college is important. Discuss the importance of using a database program and the benefits with the college dean.

Program support from the vendor also is important. One difficulty was that Scantron is located in California and UCRWC is located in Ohio. On several occasions, problems with the programs occurred at 8 AM, but I couldn’t get help from the vendor until 11 AM. At times, the phone lines were busy. Then I had to wait for long periods. Difficulties with the ParTEST program happened more frequently than with the ParSCORE program. Sometimes it took many contacts with the company to solve the problem.

**CONCLUSION**

The coordinator of a computer database testing and analysis program needs to be prepared to work closely with the support staff and to be open to changing ideas and concepts. Constant evaluation and flexibility contributes to better implementation. Support from fellow team members and peers throughout the process is essential and appreciated.

I found the commitment rewarding and believe other educators would also. By choosing to be the coordinator, I was introduced to methods that helped improve testing and student outcomes. The successful completion of the implementation reinforced my commitment to a computer database system for test measurement and improvement of critical thinking on the part of students.

Implementing and using a computer database testing and analysis program is an educational and technological endeavor requiring a long-term commitment. Nursing educators, with support and a willingness to learn, can implement a computer database program to improve their nursing programs outcomes and their graduates’ success.

A computer database testing and analysis program is very beneficial to a nursing program. The UCRWC
Associate Degree Nursing Program has seen an improvement in the NCLEX pass rate since implementation of the ParSYSTEM. Faculty have an item bank of test questions. They use statistical data to measure the validity and reliability of tests. Testing is evaluated scientifically through statistical analysis and the evaluation is used to help improve multiple-choice questions. The computer database provides data for the nursing program to use for evaluation related to curriculum and student outcomes for accreditation purposes. The ParSCORE and ParTEST programs helped to meet the needs of the UCRWC Associate Degree Nursing Program.

REFERENCES