DEVELOPING A PRELICENSURE EXAM FOR CANADA: AN INTERNATIONAL COLLABORATION

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Nine previously conducted studies indicate that Elsevier’s HESI Exit Exam (E²) is 96.36%–99.16% accurate in predicting success on the National Council Licensure Examination for Registered Nurses. No similar standardized exam is available in Canada to predict Canadian Registered Nurse Examination (CRNE) success. Like the E², such an exam could be used to evaluate Canadian nursing students’ preparedness for the CRNE, and scores on the numerous subject matter categories could be used to guide students’ remediation efforts so that, ultimately, they are successful on their first attempt at taking the CRNE. The international collaboration between a HESI test construction expert and a nursing faculty member from Canada, who served as the content expert, resulted in the development of a 180-item, multiple-choice/single-answer prelicensure exam (PLE) that was pilot tested with Canadian nursing students (N = 175). Item analysis data obtained from this pilot testing were used to develop a 160-item PLE, which includes an additional 20 pilot test items. The estimated reliability of this exam is 0.91, and it exhibits congruent validity with the CRNE because the PLE test blueprint mimics the CRNE test blueprint. (Index words: HESI Exit Exam; Predictive testing; Licensure exam; International collaboration; Standardized testing) J Prof Nurs 29:S48–S52, 2013. © 2013 Elsevier Inc. All rights reserved.

CANADA PROVIDES EDUCATION in two languages, English and French. Of the 138 Canadian schools of nursing offering baccalaureate or diploma nursing degrees, 85 (61.59%) provide instruction in English, and 53 (38.41%) provide instruction in French (Canadian Nurses Association, 2011a). However, in 2010, only 3% of the 7,478 Canadian nursing program graduates who took the Canadian Registered Nurse Examination (CRNE) for the first time took it in French. Of great concern to Canadian nursing faculty was the decreasing CRNE pass rate for first-time candidates, which fell from 96% in 2005 to 90% in 2009 and further fell to 88.9% in 2010 (Canadian Nurses Association, 2010, 2011b, 2011c). Because of the declining CRNE pass rate, Canadian nurse educators were interested in evaluating students’ preparedness for the CRNE so that their weaknesses could be identified and remediated prior to taking the licensing exam, thereby increasing CRNE pass rates. Elsevier’s HESI Exit Exam (E²) is used for this purpose in the United States. The E² is a highly accurate (96.36% to 99.16%) predictor of National Council Licensure Examination for Registered Nurses (NCLEX-RN) success (Adamson & Britt, 2009; Langford & Young, 2013; Lauchner, Newman, & Britt, 1999; Lewis, 2005; Newman, Britt, & Lauchner, 2000; Nibert & Young, 2001; Nibert, Young, & Adamson, 2002; Young & Willson, 2012, Zweighalt, 2013). Because most of the Canadian nursing graduates took the CRNE in English and because the E² is regarded as a reliable and valid exam, an international collaboration was initiated to design and evaluate a prelicensure exam (PLE) for Canadian nursing students. The partnership was formed between a testing design specialist from Elsevier’s HESI Assessment division in Houston, TX, who served as the test construction expert for this project and a Canadian nursing faculty member from Toronto, Ontario, who served as the content expert for this project. The test

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construction expert was familiar with test design principals and statistical exam analysis, and the content expert was familiar with the Canadian nursing education system. These two nurses met face-to-face on several occasions and collaborated electronically for over 2 years to design, implement, and evaluate a PLE for Canadian nursing students.

**CRNE Description**

The CRNE is a paper-and-pencil exam containing 200 items, 20 of which are pilot items that do not contribute to the exam’s score. The test items contained on the CRNE are based on clinical scenarios, followed by multiple-choice/single-answer questions. The Canadian Nurses Association is responsible for designing and administering the CRNE. The CRNE test blueprint is composed of three components: four nursing competency categories, five contextual variables, and three cognitive ability taxonomies. The Canadian Nurses Association identified 148 competencies that new graduates are expected to perform, all of which are reviewed and evaluated annually by content experts. These 148 competencies are divided into four competency categories, and the distribution of test items according to these categories is described in the CRNE test blueprint: professional practice (14%–24%); nurse–client partnership (9%–19%); health and wellness (21%–31%), and changes in health (40%–50%). Five contextual variables qualify the content domain by specifying the nursing contexts in which the CRNE test items are set. They include health care recipient (individuals, families, and groups/populations/communities), lifespan (situations relevant to all life phases), diversity (avoidance of stereotypes), health situations (situations that reflect the continuum of health and illness), and practice environment (entry-level registered nursing practice setting or circumstance). The cognitive taxonomy minimums described in the CRNE test blueprint are application (40%), knowledge/comprehension (10%); Bloom, 1956), and critical thinking (40%). For the CRNE, the critical thinking taxonomy is defined as higher level thinking processes, including making judgments and dealing with abstractions to solve nursing problems. The remaining 10% of the test items can belong to any one of these three cognitive taxonomies (Canadian Nurses Association, 2009).

**Methods**

The test construction expert conducted a crosswalk, defined as the process of linking two or more classification systems (Grossman, 2003), in which the CRNE test blueprint was compared with the NCLEX-RN test blueprint (see Table 1). The content expert participated as needed in the crosswalk process, and working together, the two experts designed a hierarchical model that organized the components of the CRNE test blueprint. The PLE was designed to provide scores on the four competency categories, two of the five contextual variables—health care recipient, defined by three sub-categories (individuals, families, or groups/populations/communities) and health situations, defined by four subcategories (maternal/paternal—child, adult, older adult, or mental health)—and the three cognitive ability taxonomies (see Figure 1). The CRNE competency categories that were congruent with the NCLEX-RN client needs categories, as reflected in the crosswalk findings, served as a guide when selecting test items from the proprietary HESI test item database. Furthermore, the test item selection process ensured that the distribution of test items was congruent with the CRNE test blueprint in terms of the three cognitive ability taxonomies. The selected test items were categorized by the three sub-categories of health care recipient and the four subcategories for health situations so that scores could be provided on the subject matter topics. The content expert conducted multiple qualitative reviews of HESI test items to determine if the questions conformed to British English idioms and usage, as well as Canadian social and cultural mores.

During the test item selection process, the test construction expert evaluated potential test items to determine if they met HESI’s statistical standards described by Morrison, Adamson, Nibert, and Hsia (2004) and that the test items also met the four criteria for critical thinking test items (Morrison, Nibert, & Flick, 2006). Test items’ statistical data are derived from item analysis findings obtained from all previous administrations of the test items. Specifically, these criteria included a difficulty level of 40% or higher and a point biserial correlation coefficient (PBCC) of 0.15 or higher. The cumulative difficulty level and PBCC for a test item are the calculated means of these measures. These data are stored with each test item in the HESI test item database, thereby providing search criteria when selecting test items. The HESI criterion of a 40% difficulty level indicates that a mean of 40% or more of those who answered the test item on any HESI exam in which the test item appeared answered it correctly. The PBCC is a measure of a test item’s ability to discriminate between those who know the content and those who do not know the content. The PBCC ranges from −1 to +1, and the closer it is to 1, the more discriminating the test item. The HESI criterion of a PBCC of 0.15 reflects the mean PBCC for all administrations of the test item on any HESI exam and indicates that the test item is adequately discriminating. The minimum difficulty level of 40% is a requirement for a test item to be included in any HESI exam. However, the PBCC for individual test items can vary, as long as the mean PBCC for all test items included in an exam is 0.15 or higher. Maintaining these statistical parameters helps to ensure that the estimated reliability of an exam, as measured by the Kuder–Richardson Formula 20 (KR20), is maintained at or higher than 0.90. This estimated KR20 projects the reliability of an exam prior to its administration and is calculated based on item analyses data obtained from all previous administrations of all the test items contained on an exam (Morrison et al., 2004, 2006).
Table 1. Crosswalk of the NCLEX-RN Client Needs Categories With the CRNE Competencies

<table>
<thead>
<tr>
<th>NCLEX-RN test blueprint client needs categories</th>
<th>NCLEX-RN %</th>
<th>CRNE test blueprint competencies</th>
<th>CRNE %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe and effective care</td>
<td>Total: 24–36</td>
<td>Professional practice: Personal and interdisciplinary practice</td>
<td>14–24</td>
</tr>
<tr>
<td>• Management of care</td>
<td>16–22</td>
<td>of safe, compassionate, competent, and ethical care</td>
<td></td>
</tr>
<tr>
<td>• Safety and infection control</td>
<td>8–14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health promotion and maintenance</td>
<td>Total: 6–12</td>
<td>Health and wellness: Population and primary health care across the lifespan</td>
<td>21–31</td>
</tr>
<tr>
<td>Psychosocial integrity</td>
<td>Total: 6–12</td>
<td>Nurse–Client partnership: Therapeutic communication based on client uniqueness of culture/spiritual, sexual orientation, learning, death/grief, and coping strategies. Incorporates legal aspects of consent and working with groups</td>
<td>9–19</td>
</tr>
<tr>
<td>Physiological integrity</td>
<td>Total: 40–64</td>
<td>Changes in health across the lifespan, inclusive of: health promotion; illness prevention; and acute, chronic, rehabilitative, palliative, and end-of-life care</td>
<td>40–50</td>
</tr>
<tr>
<td>• Basic care and comfort</td>
<td>6–12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Pharmacological and parenteral therapies</td>
<td>13–19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Reduce risk potential</td>
<td>10–16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Physiological adaptation</td>
<td>11–17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Adapted from the National Council State Boards of Nursing (2010).
† Adapted from the Canadian Nurses Association (2009).

Construction of HESI exams is based on the conceptual model described by Morrison et al. (2006). This model applies the concept for writing critical thinking items, which is measured by ensuring that test items meet the four criteria for critical thinking test items: (a) contain a rationale; (b) are written at the application or above cognitive level; (c) require multilogical thinking to answer correctly; and (d) require a high level of discrimination to choose from among plausible alternatives (Morrison et al., 2006). All questions stored in the HESI test item database include a rationale that explains why the answer to the question is correct and why the other choices are incorrect. Descriptions of cognitive level (Anderson et al., 2001; Bloom, 1956) and a listing of verbs associated with cognitive levels (Morrison et al., 2006, p. 23) are used as sources to ensure that test items are written at the application or above cognitive level. Critical thinking test items require multilogical thinking to answer correctly, which means that knowledge of more than one fact or concept is needed to solve the clinical problem presented in the question. A high level of discrimination is also required to answer critical thinking questions correctly, which means that test items should ask questions such as what is best, most important, has the highest priority, or the answer choices should be so plausible that the student is required to think carefully when choosing the answer. The test construction expert reviewed all selected test items to ensure that they met the four criteria for a critical thinking test item.

Ultimately, 242 test items were selected from the HESI test item database for review and editing by the content expert. The selected questions met the HESI criteria for difficulty and discrimination—all had a minimum difficulty level of 40% and a PBCC of at least 0.15. Additionally, the review of the selected test items by the test construction expert indicated that, with the exception of science questions, the selected items met the four criteria for critical thinking test items. Science questions, mainly anatomy and physiology test items, were selected to meet the test blueprint requirement for 10% knowledge/comprehension questions. The content expert edited 25 (10.33%) of the 242 selected test items to ensure that they reflected concepts related to Canada's health care delivery system, sociolinguistic usage, and sociocultural sensitivity. These 25 edited test items served as exemplars for editing the remaining 217 test items. The test construction expert and the content expert collaborated in categorizing the selected test items according to the four CRNE nursing competency categories, the three health care recipient subcategories, the four health situation subcategories, and the three cognitive ability taxonomies.

**Alpha and Beta Testing**

Of the 242 selected HESI test items that were edited and categorized by the content expert and the test construction expert, 180 were included in the PLE. In an effort to ensure congruent validity, which indicates that the PLE measures the same content that the CRNE measures, the PLE was designed to mimic the CRNE test blueprint. Alpha testing of the PLE was conducted in 2011 (N = 168). HESI test administration software, which emulates the NCLEX-RN, was used to administer the exams. This software program produces a HESI score and a conversion score for the entire exam and a HESI score for each of the subject matter categories. A proprietary mathematical model is used to calculate HESI exam scores, which range from 0 to approximately 1,500. The highest score is dependent on the difficulty level of all the test items.
included in the exam. The software also produces a conversion score, which is presented as a percentage and reflects the average difficulty for all test items included in the exam and the average difficulty level of the test items answered correctly. Essentially, the conversion score is a percentage score that is weighted by the difficulty level of the test items answered correctly. The more difficult the items are that are answered correctly, the higher is the conversion score. Students received their scoring report at the completion of the exam, and faculty received a summative report after the exams were uploaded to HESI for scoring.

Results

The alpha testing determined that the HESI test administration software performed as expected—the students and exam administrators were able to manipulate the functions effectively. The item analysis data obtained from the alpha testing were reviewed, but because of the small sample size \( N = 7 \), no changes were made to the exam. The seven alpha testing scores were combined with beta testing scores \( N = 168 \), and the item analysis data provided by the combined group \( N = 175 \) were reviewed by the test construction expert in consultation with the content expert. Based on this review of the 180 test items, 160 test items (88.89%) had a difficulty level of 40% or higher, and 136 (75.56%) of the test items had a PBCC of 0.15 and higher. Of the 180 test items, 20 (11.11%) did not meet HESI's criteria for difficulty level, so these items were edited, and the edited versions of the test items will be pilot tested with future administrations. Of the 242 test items that were selected from the HESI test item database and were edited for Canadian use, only 180 were used for the alpha and beta PLE. The remaining 62 test items will be pilot tested with future administrations of the PLE so that item analysis data based on Canadian usage can be obtained, thereby increasing the number of test items available for use on the PLE. As more test items become available for Canadian use, new, parallel versions of the PLE can be developed.

Discussion

Based on the international collaboration of two nurses—one, a testing design expert at Elsevier's HESI division and the other, a content expert at a Canadian University—a 160-item PLE was developed and is now available for commercial use. This exam meets HESI's statistical standards. The mean difficulty level for the 160 test items contained on this exam is 70.7%, and the mean PBCC for these same test items is 0.16. The estimated reliability for this exam is 0.91, which indicates that the PLE is a reliable exam. The PLE test blueprint is congruent with the CRNE test blueprint; therefore, the PLE exhibits congruent validity with the CRNE. The test items selected from the HESI test item database for use on the PLE were edited to reflect the Canadian health care delivery system, as well as Canadian sociolinguistic usage and sociocultural sensitivity, so that the exam is unbiased. To increase the number of test items available for use on the PLE, 20 test items are piloted with each administration of the PLE. HESI scoring software provides item analysis data on every test item administered and updates these data with every use of the test item. Therefore, as more PLEs are administered, the Canadian test item database can be expected to increase. If the PLE is used to measure Canadian students' preparedness for the CRNE in the same way that the E² is used to measure U.S. students' preparedness for the NCLEX-RN and remediation is prescribed based on subject matter scores, then parallel versions of the PLE should be developed to measure the effectiveness of students' remediation efforts. Increasing the number of test items that have item analysis data based on Canadian students' usage is therefore essential to developing parallel versions of the PLE.

The CRNE is currently a paper-and-pencil test. However, the PLE was administered using HESI test administration software, which emulates NCLEX-RN computerized testing. In December 2011, The College of Nurses of Ontario announced that the National Council of State Boards of Nursing, which is responsible for designing and implementing the NCLEX-RN, had been selected to partner in the development of a state-of-the-art, computer-adaptive, registered nurse (RN) entry exam, which will be implemented in 2015. The new Canadian licensing exam for RNs will have computer features that make it affordable, accessible year round, and provide results within 48 hours, which allows for timely registration of nursing candidates. The PLE provides students with the experience of taking a...
computerized exam and is likely to help prepare candidates for the 2015 implementation of a computerized licensing exam.

The student participants in the alpha and beta testing of the PLE were all volunteers, which could have influenced the findings of this study. The data provided from the students’ exam scores are only as valid as the commitment of the students who took the exam. Future use of the PLE might provide more valid data if the students’ scores have consequences. For example, if students are required to complete a remediation program based on their PLE scores, or if the PLE counts as a portion of the students’ course grade, then it is more likely that the scores will reflect the students’ true skills and less likely that spurious data are obtained. Future studies might compare the PLE results that have consequences with those that do not. Additionally, the validity of the PLE should be examined in terms of its predictive accuracy. Following the research design of the nine E² validity studies, the PLE should be evaluated to determine its accuracy in predicting licensure success and its usefulness in assisting students to prepare for the licensing exam.

Conclusion

The development of the PLE was the result of a successful international collaboration between a Canadian nursing faculty member who served as a content expert and a HESI test construction expert. Their collaborative efforts produced an exam that emulates the CRNE test blueprint and is administered online so that it helps to prepare students for the 2015 implementation of CRNE computerized testing in Canada. The PLE provides subject matter scores that can be used to help prepare students for the CRNE. Based on item analysis data obtained in the alpha and beta testing, the PLE is a reliable exam, as evidenced by an estimated KR20 of 0.91, and because it mimics the CRNE test blueprint, the PLE is a valid exam. Canadian nursing faculty can therefore confidently use the PLE to predict students’ preparedness for the CRNE and can use the subject matter scores provided by the PLE to help remediate students so that they are ultimately successful on their first attempt at taking the CRNE.

References


