

Methods for the Development and Validation of New Assessment Instruments in Nursing Education

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Disclosure

The authors of this presentation are current employees of an educational software company that produces virtual patient simulations for health professions education.

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Overview of Presentation

- ◎ Virtual Patient Simulations
- ◎ Virtual Patient Assessment
 - ◎ Clinical Reasoning
- ◎ The Student Performance Index
 - ◎ Discovery
 - ◎ Instrument Development
 - ◎ Pilot Test
- Conclusions and Implications for Practice

Virtual Patient Simulations

- Asynchronous, computer-based clinical simulations in which nursing students interview and examine virtual patients



Virtual Patient Assessment

“The outcomes assessed during or after VP interventions should focus on clinical reasoning or at least application of knowledge, rather than the lower levels of knowledge, such as recall... Ideally, all-or-nothing grading (diagnosis or management strategy correct or incorrect) would be replaced or supplemented by measures that assess the clinical reasoning process.”

(Cook & Triola, 2009, p.308)

Discovery

Subject Matter Experts

- Three day working group
 - Comprised of current faculty users and experts in clinical reasoning in nursing
- Explored clinical reasoning
 - How nurses apply clinical reasoning in practice
 - Challenges facing nursing faculty in teaching
 - How faculty were already using virtual patient simulations to assess their students' clinical reasoning abilities

Clinical Reasoning Conceptual Framework



Clinical Simulation

- Pre-Exam
- Pre-brief
- Interview & Examine
- Collecting data
- Processing information*
- Post-Exam
- Self-reflection

Communication

- Building Rapport
- Expressing Empathy
- Cultural Competence
- Patient Education
- Patient Safety

Context

- Patient Case
- Virtual Patient Art
- Virtual Patient Animation
- Virtual Patient Dialogue

*Identify problems, prioritization, goals and plan

Assessing Clinical Reasoning in Virtual Patient Simulations

- Foundational components of clinical reasoning within the virtual patient simulations
 - Considering the patient context while collecting **subjective and objective patient data**
 - Providing **therapeutic communication through patient education and empathy**
 - Documenting findings
 - **Processing the information** collected as evidence to diagnose, prioritize, and plan for the treatment of problems
 - Self-reflection

Development

Transcript Analysis

- Undergraduate (BSN & RN-BSN) and graduate (MSN) faculty who had used the virtual patient program for at least two semesters each identified six Health History assignment transcripts from their courses (18 total)
 - Two *below average* students
 - Two *average* students
 - Two *above average* students
- The faculty also coded their transcripts for the indicators of clinical reasoning that led to the categorization
- Analysis identified three themes of the coded indicators
 - Addressed or failed to address patient context
 - Made or failed to make appropriate empathetic statements
 - Made or failed to provide appropriate patient education
- The consolidated codes and themes were member-checked in both asynchronous review and semi-structured interviews

Content Validation

- Content validity was established
 - Reviewed the drafted instrument content through asynchronous reviews
 - Confirmed the instruments as discrete measurements of clinical reasoning within the conceptual framework
- Evidence of face validity was established
 - Cognitive interviews

Data Collection

- Instrument Dimensions
 - Chief Complaint and HPI
 - Medical History
 - Medications
 - Allergies
 - Immunizations
 - Family and Psychosocial History
- Interview Questions
 - 72 BSN/RN-BSN foundational items
 - 88 MSN foundational items
- Patient Data
 - 153 BSN/RN-BSN depth items
 - 204 MSN depth items

Subjective Data Collection : 80 of 88 (90.9%)

Hover To Reveal...
Hover over the **Patient Data** items below to reveal important information, including **Pro Tips** and **Example Questions**.

● Indicates an item that you found.
● Indicates an item that is available to be found.

| Category | Interview Questions | Patient Data |
|--------------------------------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Experts selected these topics as essential components of a strong, thorough interview with this patient. | A combination of open and closed questions will yield better patient data. The following details are facts of the patient's case. Please Note: these items are for your information, and are not included in the Subjective Data Collection score. |
| History of Presenting Illness: Foot Wound | | |
| | <input checked="" type="checkbox"/> Established chief complaint | <input checked="" type="checkbox"/> Reports pain <input checked="" type="checkbox"/> Reports open foot wound |
| | <input checked="" type="checkbox"/> Asked to rate pain on a scale | <input checked="" type="checkbox"/> Rates present pain at a 7 out of 10 |
| | <input checked="" type="checkbox"/> Asked for details about the pain | <input type="checkbox"/> Describes the pain as throbbing <input checked="" type="checkbox"/> Describes the pain as sharp when she attempts to stand <input type="checkbox"/> Initial injury began 1 week ago <input checked="" type="checkbox"/> Pain has increased in the past 2 days <input type="checkbox"/> Reports feeling pain radiating into ankle |

Education & Empathy Opportunities

- Patient responses that represent an empathetic moment or indicate a knowledge gap that needs to be addressed
 - Assesses students' recognition of opportunities, not the quality of the content
- 9 BSN/RN-BSN opportunities
- 12 MSN opportunities

Education & Empathy : 3 of 12 (25.0%)

During the patient interview, there are a number of opportunities to provide patient education and empathy. The opportunities listed below are those identified by nursing experts to be of particular importance to this patient. A **Model Statement** is provided as an example of an appropriate response to each opportunity.

- Opportunities marked as **Not Encountered** are opportunities that were not elicited in the interview
- Opportunities marked as **Not Followed Up** are missed opportunities that were present in the interview, but where no statements were made
- Opportunities marked as **Followed Up** were followed up by students, and include the dialogue between student and patient

> 1 Expression of pain

Followed Up

> 2 Impact of injury on daily life

Not Encountered

▼ 3 Gaps in health literacy around diabetic diet

Followed Up

● **Description:** Tina describes controlling her diabetes by avoiding "sweets."



What do you do to take care of your diabetes?

Question
12:56 PM EDT



I just watch what I eat and try to stay away from sweets.



Watching about what you eat is important for diabetes. Diabetes will also influence how your wound heals.

Educate
12:56 PM EDT



Thanks for telling me.

● **Model Statement:** "Staying away from sugar is a great start. I can give you some more information on what a balanced diet looks like for someone with diabetes. For example, many starchy foods break down into glucose in the body, like pasta, and so you can eat those in moderation, too. Most people with diabetes feel better when they limit all starches, eat protein, and take regular medication."

> 4 Lack of treatment with diabetes medication

Not Followed Up

> 5 Lack of blood glucose monitoring

Not Followed Up

Information Processing

- Information Processing activity involves three steps:
 - Identifying patient data and responses in the student's transcript as evidence of one or more diagnosis
 - Prioritizing the identified diagnoses
 - Constructing an appropriate plan for further assessment, intervention, or patient education for each diagnosis
- Three experts from each learning population reviewed a draft of the activity to categorize each diagnosis and identify its priority
 - *Do include: this diagnosis applies to the patient*
 - *Do include as an incorrect choice*
 - *Do not include: this diagnosis would be confusing*
 - *Do not include: this diagnosis is too obviously incorrect*
 - *I am not sure if the diagnosis should be included*
- NANDA International 2015-2017 Nursing Diagnoses for BSN/RN-BSN
 - 17 NANDA diagnoses (9 correct, 8 incorrect) in BSN/RN-BSN
- ICD-10 coding for MSN
 - 19 ICD-10 diagnoses (12 correct, 5 incorrect) in MSN

Information Processing (cont.)

- For each correct diagnosis, a maximum score of 4 points is possible
 - 2 points for providing strong, salient evidence for the diagnosis
 - 1 point for supporting evidence without the presence of strong evidence
 - 1 point for correct prioritization the diagnosis
 - 1 point for identifying at least one correct action item in the construction of a care plan

Information Processing : 22 of 36 (61.1%)

Each relevant diagnosis is scored on a four-point scale:

- **Priority (1 point):** the correct priority of the diagnosis was chosen
- **Evidence (up to 2 points):** the strength of the patient cue(s) selected as evidence for the identified diagnosis
 - **Required Evidence:** selecting at least one cue that **directly indicates** the presence of a problem or risk is worth 2 points
 - **Supporting Evidence:** selecting at least one cue that is a **contributing factor** or **cause** of a problem or risk, without the presence of Required Evidence, is worth 1 point
- **Planning (1 point):** the plan proposed to address the diagnosis includes at least one correct component

Relevant Diagnoses

> 1. Acute pain 4 of 4 points

▼ 2. Impaired skin integrity 3 of 4 points

Priority 1/1

Student Response: ✓ High

Correct Priority: High

● **Priority Pro Tip:** This is a high priority. The infection is the most immediate threat to the patient's health, and the wound is at risk for delayed healing because of the patient's uncontrolled blood glucose.

Evidence 1/2

Relevant

"Well, I got the scrape a week ago, but the scrape and the pain got a lot worse in the last few days." **Supporting Evidence**

● **Evidence Pro Tip:** As Tina discusses symptoms of her wound, including symptoms such as discharge, redness, warmth, and swelling, she reports strong evidence of impaired skin integrity.

Irrelevant

(None provided)

Planning 1/1

Relevant

Assess - Integumentary: Assess the patient's skin color.

Assess - Integumentary: Assess the patient's skin moisture and turgor.

Assess - Integumentary: Assess the patient's skin, inspecting for lesions.

● **Planning Pro Tip:** Because wound infections impact the patient's overall health, it's important to assess perfusion, hydration, and swelling. Assess the status of the wound itself and ensure proper cleaning and dressing per the physician's order. Prevent worsening infection by educating the patient about wound care and self-monitoring.

Irrelevant

(None provided)

Pilot Test

Pilot Test Participants

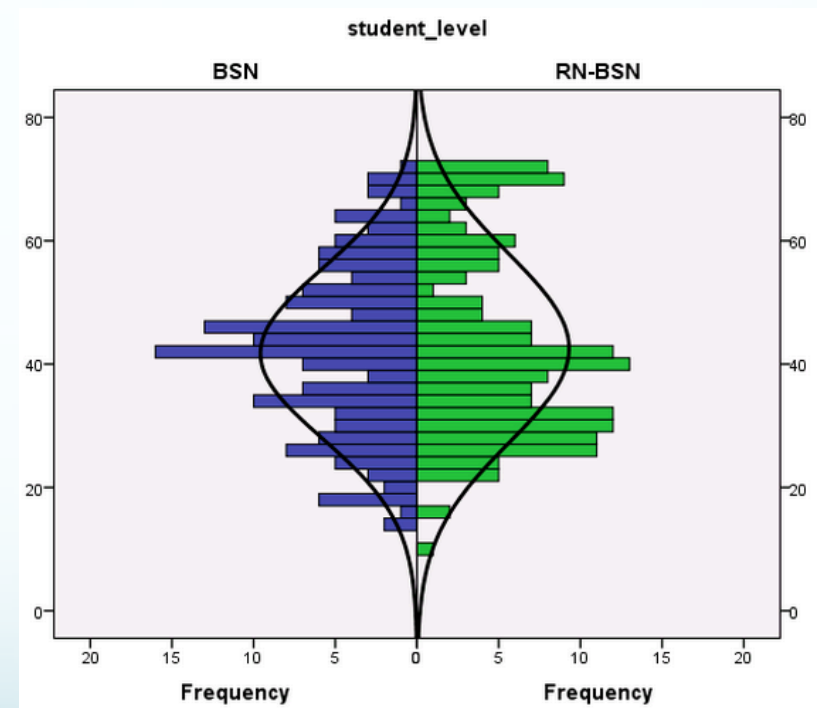
- Almost 500 students used the Student Performance Index in Spring 2015
 - 165 BSN students in 2 different programs (33%)
 - 178 RN-BSN students in 7 programs (36%)
 - 154 MSN students in 2 programs (31%)
- Participants demographics
 - Mostly Female (~90%)
 - White (~65%)
 - 18-25 years old for BSN; 26-40 for RN-BSN and MSN
 - English speaking (~95%)
 - Full-time students for BSN (95%); and employed for wages for RN-BSN and MSN (~90%)
 - Majority of BSN students had no professional experience for BSN (49%), while most RN-BSN and MSN students had an average of 2-5 years of experience

Pilot Test Results: Assignment Metrics

| Assignment Metrics | | Interview Time | IP Time | Total Time | Interview Questions | Empathy State. | Education State. | Doc. Words |
|--------------------|--------|----------------|---------|------------|---------------------|----------------|------------------|------------|
| BSN | Mean | 91.1 | 19 | 139.8 | 112.5 | 4.9 | 5.2 | 324.8 |
| | Median | 85 | 15 | 123 | 103 | 4 | 4 | 296 |
| | SD | 46.7 | 12.4 | 119.8 | 59.2 | 3.8 | 4.6 | 199.5 |
| RN-BSN | Mean | 95.3 | 22.7 | 174.2 | 108.3 | 7 | 7.1 | 314.3 |
| | Median | 81 | 19 | 123.5 | 91 | 5 | 5 | 258 |
| | SD | 65.7 | 15 | 337.1 | 65.2 | 7.8 | 7.3 | 255 |
| MSN | Mean | 146.8 | 36.5 | 201.8 | 143.5 | 7.8 | 8.5 | 528 |
| | Median | 136.5 | 32 | 180 | 137 | 6.5 | 7 | 482 |
| | SD | 90.5 | 23.9 | 102.7 | 55.6 | 6.5 | 7 | 264 |

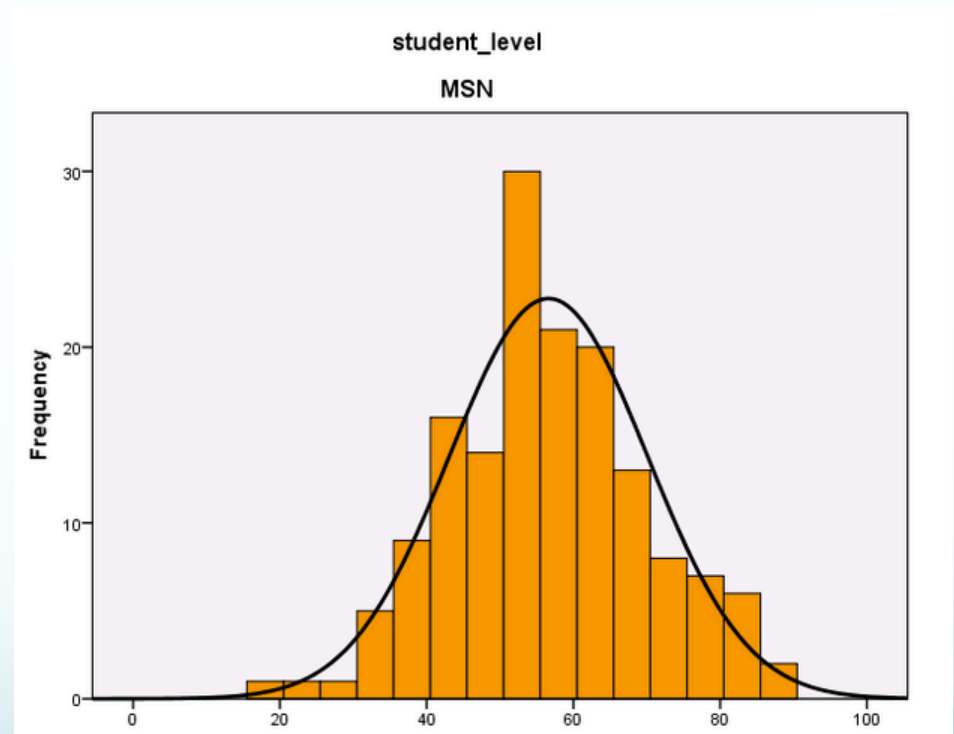
Pilot Test Results: BSN/RN-BSN Score Comparison

| Interview Question Items | Student level | |
|-----------------------------|---------------|--------|
| | BSN | RN-BSN |
| Mean | 41.7 | 42.6 |
| Median | 42 | 40 |
| SD | 13.7 | 15.2 |
| 25 th percentile | 31.5 | 30 |
| 50 th percentile | 42 | 40 |
| 75 th percentile | 51.5 | 55 |
| <i>t</i> | .527 | |
| <i>df</i> | 341 | |
| Sig. | .598 | |



Pilot Test Results: MSN Score Distribution

| Interview Question Items | MSN |
|-----------------------------|------|
| Mean | 56.6 |
| Median | 55.5 |
| Mode | 45 |
| SD | 13.5 |
| 25 th percentile | 47.8 |
| 50 th percentile | 55.5 |
| 75 th percentile | 65 |



Item Analysis: Difficulty and Discrimination for Data Collection

- Item analysis was conducted to examine how well the Interview Question items discriminated between high- and low-achieving students
 - Item difficulty
 - The percentage of students that asked each Interview Question
 - Item discrimination index
 - The biserial correlation between asking an Interview Question and the overall score on Data Collection
- Items of moderate difficulty (asked by at least 25% of the students) tend to discriminate well between different levels of student performance
 - Very difficult items (asked by $< 25\%$ of students) are usually not appropriate discriminators, very easy items (asked by $> 75\%$ of students) may serve other instructional purposes within the instrument rather than to discriminate among students (e.g., minimum content coverage)
- Items with a biserial correlation of .20 or higher discriminate well between different levels of student performance

Reliability Analysis for Data Collection

- Internal consistency reliability was estimated using Cronbach's alpha
 - The extent to which the items measuring students' data collection skills produce similar and consistent scores
 - A Cronbach's alpha value of at least .70 is considered a good indicator of internal consistency
- Internal consistency was estimated separately for the BSN, RN-BSN, and MSN student population scores

Item Analysis and Reliability Results

| | Student Population | | |
|-----------------------------------|--------------------|--------|-----|
| | BSN | RN-BSN | MSN |
| Number of students | 165 | 178 | 163 |
| Number of items | 70 | 70 | 86 |
| Average item difficulty | 56% | 57% | 61% |
| Average item discrimination index | .42 | .46 | .47 |
| Cronbach's alpha | .94 | .96 | .96 |

Behavior of Data Collection Items

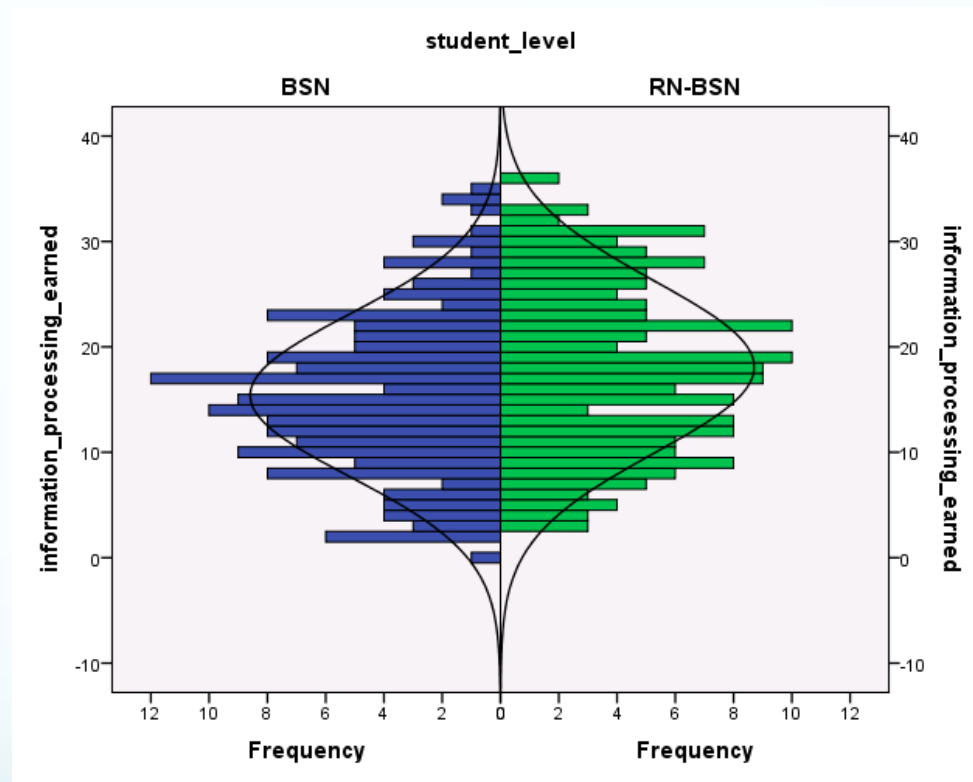
| | Discrimination | | | | | |
|------------|---------------------|----------------|------------------------|----------------|---------------------|----------------|
| | BSN (items = 70) | | RN-BSN (items = 70) | | MSN (items = 86) | |
| Difficulty | Less than .20 | .20 or greater | Less than .20 | .20 or greater | Less than .20 | .20 or greater |
| < 25% | 0 (0%) | 8 (11.4%) | 0 (0%) | 5 (7.1%) | 0 (0%) | 7 (8.1%) |
| 25% - 75% | 0 (0%) | 46 (65.7%) | 0 (0%) | 49 (70%) | 0 (0%) | 48 (55.8%) |
| > 75% | 5 (7.1%) | 11 (15.7%) | 5 (7.1%) | 11 (15.7%) | 0 (0%) | 31 (36%) |

Education & Empathy Opportunities Analysis: BSN/RN-BSN Comparison

| Education and Empathy Opportunities | Opportunities Encountered | | Opportunities Followed-up | |
|-------------------------------------|---------------------------|--------|---------------------------|--------|
| | BSN | RN-BSN | BSN | RN-BSN |
| Mean | 4.32 | 5.12 | 1.81 | 2.8 |
| Median | 4 | 5 | 2 | 2 |
| Mode | 5 | 4 | 2 | 2 |
| SD | 1.95 | 2.24 | 1.28 | 2.1 |
| 25 th percentile | 3 | 3 | 1 | 1 |
| 25 th percentile | 4 | 5 | 2 | 2 |
| 75 th percentile | 6 | 7 | 3 | 4 |
| <i>t</i> | 3.548 | | 5.361 | |
| <i>df</i> | 339.759 | | 297.061 | |
| Sig. | .000* | | .000* | |

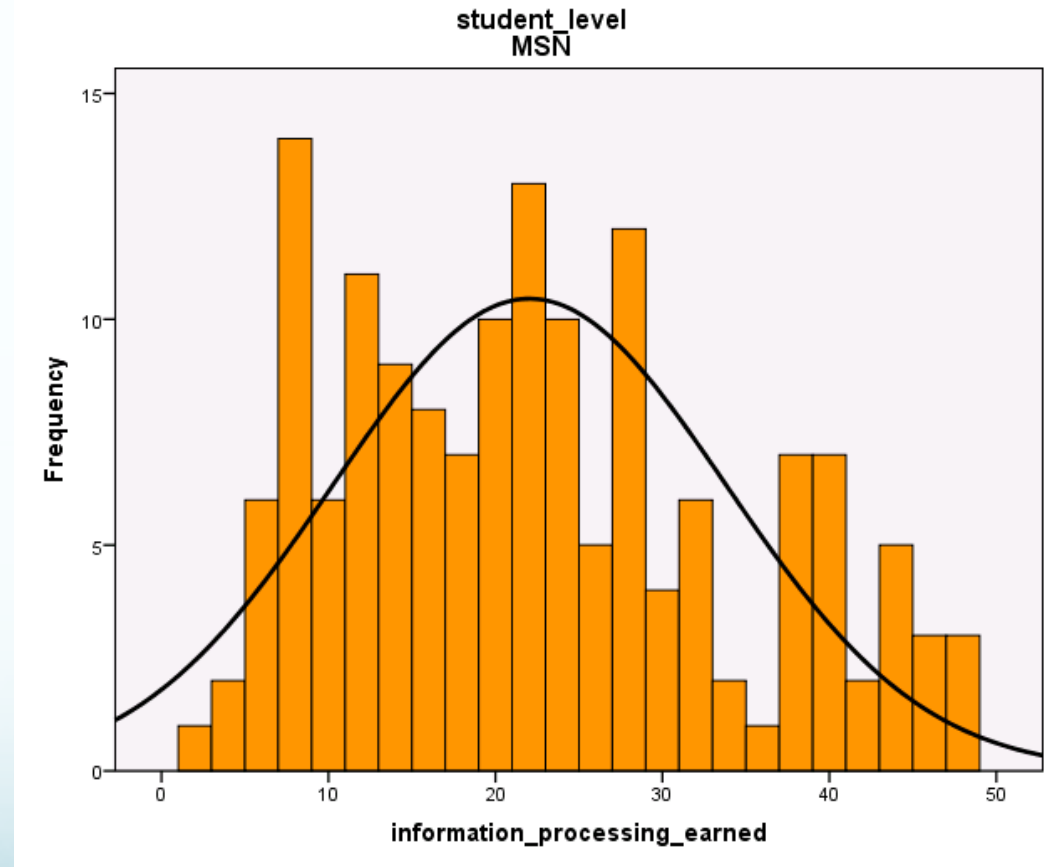
Information Processing Analysis: BSN/RN-BSN Comparison

| Undergraduate Information Processing | Student level | |
|--------------------------------------|---------------|--------|
| | BSN | RN-BSN |
| Mean | 15.41 | 18.1 |
| Median | 15 | 18 |
| Mode | 17 | 19 |
| SD | 7.66 | 8.16 |
| 25 th percentile | 10 | 11.75 |
| 50 th percentile | 15 | 18 |
| 75 th percentile | 20.5 | 24.25 |
| <i>t</i> | 3.141 | |
| <i>df</i> | 341 | |
| Sig. | .002* | |



Information Processing Analysis: MSN

| Graduate Information Processing | MSN |
|---------------------------------|-------|
| Mean | 22.04 |
| Median | 21 |
| Mode | 7 |
| SD | 11.75 |
| 25 th percentile | 12 |
| 50 th percentile | 21 |
| 75 th percentile | 29.25 |



Conclusions and Implications for Practice

Conclusions

- Clinical reasoning can be measured
 - Conceptualize discrete components
 - Validate learner-appropriate assessment instruments
- Effective assessment instruments differentiate below average, average, and above average student performance

Implications for Nurse Educators

- Methods developing assessment instruments
 - Discovery
 - Literature review
 - Subject Matter Experts (SMEs)
 - Conceptual framework
 - Instrument development
 - Operationalization of constructs
 - Content validation
 - In-depth, qualitative review with SMEs
 - Pilot testing
 - Item analysis and reliability
 - Known-groups performance comparison
 - Instrument refinement

Thank you!

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