Innovations in Numeracy Support for Healthcare

Establishing a numeracy assessment benchmark in nursing: The focus and design of a NES commissioned research study

NHS Education for Scotland (NES) Numeracy Reference Group

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- Dr Keith W Weeks (University of Glamorgan; Authentic World Ltd)
- Professor Diana Coben (King’s College London)
- Norman Woolley (University of Glamorgan; Authentic World Ltd)
Synopsis of Afternoon Presentation

• The focus and design of our study
  ➢ Focus: validating an evidence based framework within which a benchmark may be articulated
  ➢ Research design: Quasi-experimental study
  ➢ The story so far…
  ➢ Next steps…
Definition of a ‘Benchmark’

Originally:

• The chiseled horizontal marks that surveyors made in stone structures
• Usually indicated with a chiseled arrow below the horizontal line.
• It was a set point or a place of reference.

More Recently:

• A point of reference from which measurements may be made
• Something that serves as a standard by which others may be measured or judged
• A standardized test that serves as a basis for evaluation or comparison
What a benchmark assessment should look like: Principles to inform development

- **Realistic:** (Hutton, 1997; Weeks, 2001, 2007)
- **Appropriate:** (OECD, 2005; Sabin, 2001).
- **Differentiated:** (Hutton, 1997).
- **Transparent:** (Weeks et al 2001).
- **Well-structured:** (Hodgen & Wiliam, 2006)
- **Consistent with adult numeracy principles:** (Coben, 2000).
- **Diagnostic:** (Wiliam, 2006)
- **Easy to administer:** (Black & Wiliam, 1998).
With respect to numeracy for nursing, we consider such an assessment tool should be:

- **Realistic:** Evidence-based literature in the field of nursing numeracy (Hutton, 1997; Weeks, 2001) strongly supports a realistic approach to the teaching and learning of calculation skills, which in turn deserve to be tested in an authentic environment. Questions should be derived from authentic settings. A computer based programme of simulated practice in drug calculations, formative testing, with feedback on the nature of errors made, has been shown to improve competency in medication dosage calculation, which can also be demonstrated in the clinical areas (Weeks, Lyne, & Torrance, 2000). Exposure of students to real-world situations is recommended (Weeks, 2001).

- **Appropriate:** The assessment tool should determine competence in the key elements of the required competence (OECD, 2005; Sabin, 2001).

- **Differentiated:** There should be an element of differentiation between the requirements for each of the branches of nursing (Hutton, 1997).
Transparent: The assessment should be able to demonstrate a clear relationship between ‘test’ achievement and performance in the practice context (Weeks, Lyne, Mosely, & Torrance, 2001).
• **Consistent with adult numeracy principles:** The assessment should be consistent with the principles of adult numeracy learning, teaching and assessment, having an enablement focus (Coben, 2000).

• **Diagnostic:** The assessment tool should provide a diagnostic element, identifying which area of competence has been achieved, and which requires further intervention (Black & Wiliam, 1998). Thus it should “provide information to be used by students and teachers that is used to modify the teaching and learning activities in which they are engaged in order better to meet student needs. In other words, assessment is used formatively to ‘keep learning on track’”. (Wiliam, 2006).
### Well Structured, Comprehensive & Diagnostic

<table>
<thead>
<tr>
<th></th>
<th>Tablet &amp; Capsule</th>
<th>Liquid Medicine</th>
<th>Injection</th>
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<tr>
<td>Conversion SI Units</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
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<tr>
<td>Complex Arithmetic</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
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<tr>
<td>Sub &amp; Multiple Unit Dose</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>9</td>
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<tr>
<td>Unit Dose</td>
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<td>9</td>
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<td><strong>Total</strong></td>
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<table>
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<tr>
<th></th>
<th>IV Infusions</th>
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<tr>
<td>MI per Hour</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Drops per Minute</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
<td><strong>20</strong></td>
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</table>

**Grand Total: Questions = 50**

| 30 | + 20 = 50 |

The assessment tool should:
- Provide a unique set of questions with a consistent level of difficulty
- Provide a structured range of complexity
- Take place within a defined framework, at points by which students can be effectively prepared, while allowing time for supportive remediation. (Hodgen & Wiliam, 2006)
Five-Dimensional Framework for Authentic Assessment

**Task:**
- Integration of knowledge, skills & attitudes
- Meaningfulness, typicality & relevance as perceived by students
- Degree of ownership of problem & solution space
- Degree of complexity:
  - Solution space (single / multiple)
  - Structure (well / ill defined)
  - Domains (mono / multidisciplinary)

**Physical Context:**
- Similarity to professional workspace (fidelity)
- Availability of professional resources (methods / tools)
- Similarity to professional time frame (thinking / acting)

**Social Context:**
- Similar to social context of professional practice:
  - Individual work / decision making
  - Group work / decision making

**Form / Result:**
- Demonstration of competence by professionally relevant results
- Observation / presentation of results
- Multiple indicators of learning

**Criteria:**
- Based on criteria used in professional practice.
- Related to realistic product / process
- Transparent and explicit
- Criterion-referenced

Easy to Administer

The assessment should provide the opportunity for rapid collation of results, error determination, diagnosis and feedback (Black & Wiliam, 1998).

(Coben et al., in press)
What is Competence in Nursing Numeracy?

It’s NOT (for example in the case of an injection dosage problem):

What I want \_X\_ What it comes in = What I give

What I’ve got

Or

\(20 \text{ mg} \times 2 \text{ ml} = 2 \text{ ml}\)

… but whether, when presented in a particular context with a prescription with a specified dose, an ampoule with a particular strength/volume, and a choice of syringes to draw it up into, that the student and practitioner can manipulate these to produce the correct prescribed dose to be administered.
Authenticity: A fundamental shift in thinking and in the design of learning & assessment environments...

1. Understand & correctly set up the problem to be solved

2. Accurately compute the numerical calculation

3. Understand the design of the medication measurement & delivery device; accurately measure the dose to be administered
<table>
<thead>
<tr>
<th>Activity</th>
<th>Process</th>
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<tbody>
<tr>
<td>Authentic assessment of medication dosage calculation skills: (N=500 3rd year students)</td>
<td>Sample selected from 6 participating HEI’s in Scotland</td>
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<tr>
<td>Analysis of Authentic Assessment outcome data</td>
<td>50 point Authentic Assessment: Typical unit dose, sub &amp; multiple unit dose, complex problems, conversion of SI units, IV infusions</td>
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<tr>
<td>Diagnostic assessment of medication dosage calculation skills: Simulation suite environment</td>
<td>Statistical analysis: concurrent validity test</td>
</tr>
<tr>
<td>Analysis of simulation suite outcome data</td>
<td>28 point assessment via examiner observation of typical medication dosage calculation skills in simulation suite environment</td>
</tr>
<tr>
<td>Evaluation of participants perceptions of representative nature of the Authentic Assessment environment</td>
<td>Statistical analysis of concurrent validity of Authentic Assessment performance outcomes in comparison to simulation suite setting performance</td>
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</table>

50 students exposed to simulation suite followed by computer based authentic assessment environment

Evaluation via online Likert scale evaluation tool and focus group interviews. Based on Gulikers’ et al (2004) five dimensional framework
Institutional Ethics Approval

Year Three Adult Cohort - Initial visit to explain project (1 hour)

Stage 1 - Online assessment (up to 100 volunteers) (2 hours)

Simulated Clinical Task assessment
10 students (3 hrs)

Online Assessment (10 Students)

Online Assessment (10 Students)

Simulated Clinical Task assessment
10 students (3 hrs)

Completion

Stratified sample selection by research team

Once testing complete the individual test results fed back by Research team to all participants through email and access to Authentic World established
Key issues arising from the pilot study

- Pragmatics
- Computer based assessment
- Practical activity assessment
- Congruence between measurement environments
Assessment Results

You are reviewing Question 10

![Prescription Details]

**REGULAR PRESCRIPTION MEDICINES**

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<th>DOSE</th>
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<th>START DATE</th>
<th>SPECIAL INSTRUCTIONS</th>
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**KEEP OUT OF THE REACH OF CHILDREN**

Digoxin
62.5mcg in 1 Tablet

**Doctor's Signature**

Dr. Jones

**Pharmacy Supply**

A. Mann

Your Answer

Correct Answer

[Checkmark]
Assessment Results

You are reviewing Question 17

<table>
<thead>
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<td>DOCTOR'S SIGNATURE</td>
<td>PHARMACY SUPPLY</td>
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<td>Dr. Jones</td>
<td>A. Mann</td>
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Ibuprofen
100mg in 5ml

Your Answer

Correct Answer
### Assessment Results

You are reviewing Question 8

**Regular Prescription Medicines**

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<th>MEDICINE (Approved Name)</th>
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**Theophylline**

125mg in 1 Tablet

### Your Answer

- 2 pills

### Correct Answer

- 1 pill
You are reviewing Question 8

<table>
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<tr>
<th>INFUSION FLUID</th>
<th>TYPE/STRENGTH</th>
<th>VOLUME</th>
<th>ROUTE</th>
<th>INFUSION DURATION</th>
<th>MEDICINE ADDED</th>
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<tr>
<td>Sodium Chloride</td>
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Authentic World
Solution Administration Set
20 drops per ml

Your Answer

3 drops per minute

Correct Answer

28 drops per minute
Assessment Results

You are reviewing Question 6

<table>
<thead>
<tr>
<th>INFUSION FLUID</th>
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<td>I.V.</td>
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100 ml Glucose 5%

Solution Administration Set
60 drops per ml

Your Answer

- 25 drops per minute

Correct Answer

- 25 drops per minute
The benchmark – Summary

- Ensure consistency across education providers in meeting the requirements of all stakeholders, be they providers of education, the regulator, employers or the students themselves.
- Any benchmark needs to consider the levels of numeracy competence identified above and to include a strong element of process as well as outcome, based on available research evidence.
- A test of ability to calculate drug dosages competently by the end of ‘training’ should be the culmination of a programme of education and formative assessment which begins at entry to the programme and is continuous throughout the three years of the programme.
- Establishing a robust competence benchmark at this stage will allow practitioners to demonstrate achievement, universities to demonstrate effective learning and teaching strategies, and employers to support governance and patient safety.
References

References

References