How to Assist Students Visualize Their Knowledge, or One of the Five Doors to Excellence in Medical Education

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Outline

- Learning outcomes
- Steps taken in designing assessment systems
- Explain the focus on concept mapping in Medical Biochemistry Course
- Examples of students’ concept maps
- Inspiration 8.0b software
- Results
- Conclusion
Learning Outcomes

By the end of this presentation, the attendees will be able to:

• Apply the methods we used to assist students in visualizing their knowledge
• Use the most effective and appropriate technologies to support teaching and learning
• Assess achievement through the visualization of knowledge and understanding
Steps Taken to Design Assessment Systems

Based on curriculum design and program development (MEL 604), and learner assessment and program evaluation (MEL 606) principles, the following were implemented in fall 2009:

• Decreasing lecture hours (using ARS: TurningPoint)
• Including learning objectives and performance indicators for each lecture
• Creating case-based workshops
• Writing /finding clinical cases to illustrate the lecture material
• Posting case material, objectives, and guiding questions at least 48 hours before the workshop


Steps Taken to Design Assessment Systems, Continued

- Modifying the question bank to fit Haladyna’s recommendations
- **Quiz:** assess student preparedness at the beginning of the workshop (individually and in group setting)
- **Formative assessment:** use concept mapping to assess the capacity of students in visualizing their knowledge
- Using a **rubric to evaluate** and grade the concept maps
- **Case Quiz:** assess students understanding at the end of each workshop
- **Summative exams:** midterm, final, and Biochemistry Shelf Exam

Goal Setting Concept Map: Planning is Key
## Learner Assessment Chart

<table>
<thead>
<tr>
<th>Component</th>
<th>Instrument</th>
<th>Description</th>
<th>Reviewer</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Readiness</td>
<td>Regular formative assessments based on learning outcomes and performance indicators</td>
<td>The first quiz is set to assess the readiness of individual students.</td>
<td>Course director and student promotion committee</td>
<td>Weekly</td>
</tr>
<tr>
<td>Group Readiness</td>
<td>Regular formative assessments based on learning outcomes and performance indicators</td>
<td>The second one is, in fact, the same as the first one.</td>
<td>Course director and student promotion committee</td>
<td>Weekly</td>
</tr>
<tr>
<td>Learners’ Performance</td>
<td>Summative exams based on learning outcomes and performance indicators</td>
<td>Students will be given a midterm after four weeks of instruction, and a final exam at the end of the course. Item analysis of the par scores will indicate the weak points of instruction and comprehension</td>
<td>Course director and student promotion committee</td>
<td>Midterm/Block 1 and Block 2 Exam/Final, as well as biochemistry shelf exam</td>
</tr>
<tr>
<td>Professionalism and Communication Skills</td>
<td>Direct observation by faculty, peers, and staff</td>
<td>Feedback from faculty and peers will be sought regarding student interactions and behavior during group discussions</td>
<td>Course director and student promotion committee</td>
<td>Weekly</td>
</tr>
</tbody>
</table>
Rationale and Explanation of Assessments

• Students must attend 70% of the scheduled lectures in order to earn 10% of your final grade. There is no possible partial credit.
• There were six 10-point quizzes taken during the workshops individually, then in a group setting. Each quiz consisted of 10 multiple choice questions related to the most recent topics of study in Introduction to Medical Biochemistry
• There were six 10-point individual quizzes at the end of each workshop. Each quiz covered the material of the study case of the day. These quizzes were administered via Blackboard Learning System
• There was a required concept map per workshop, representing 10%. The rubric scores ranged from Excellent to poor (see rubric for details).
• The average of all quizzes represents 20% of the total grade.
• The IMB Block Exam 1 and Block Exam 2 were composed of multiple-choice questions, worth 30% each. These questions were derived from the material covered in the readings and lectures.
Concept Mapping a Visualizing Tool (Inspiration 8.0 b)

The Importance of Visualization

- **Vision** is the most dominant sense for humans
- Humans are wired to notice differences in **color** and **patterns**
- **Chunking/grouping** results in more effective use of the brain
Early Stage of Students’ Concept Map

Lactate also competes with urine for excretion. Alcohol increases the adenosine nucleotide turnover leading to elevated level of blood urate.

Kidney Disturbances:
- Buildup of urine crystals
- Increased uric acid (HYPERURICEMIA)
- Increased protein degradation
- Increased potassium

Thiazide Diuretics:
- Potential alcolol intake during vacation

Potential Drugs:
- Thiazide diuretics
- Potentially harmful in kidneys

Increased Uric Acid
- Increased Blood Pressure
- Increased Respiration Rate
- Glucose intolerance
- Increased Tryptophan

Uric Acid
- Increased Blood Pressure (potentially from consumption of alcohol)
- Increased Oxygen Consumption
- Increased Ht Blood

Blood in Urine
- Urine crystal formation in kidneys
- Urine crystal formation in joints

High Systolic:
- High blood pressure
- High uric acid

Kidney Failure:
- Presence of urate in kidneys
- Presence of urate in joints

Relevant Biochemical Pathways:
- Relevant biochemical pathways

Diagnosis:
- Based on Chief Complaint, Physical Exam, and Lab Results
- Inflammation of joints
- Hyperuricemia
- Cushing's disease
- Nephrotic syndrome
- Overproduction of uric acid
- Alcohol consumption
- High protein diet
- Uricosuric therapy
- Allopurinol (uricosuric) therapy
- Urate inhibitors

Relevant Medications:
- Colchicine
- NSAIDs
- Allopurinol
- Uricosuric agents
- Urate inhibitors

Relevant Biological Pathways:
- Relevant biological pathways

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Late Stage of Students’ Concept Map
Rubrics

BMS 680/BSCI 609

Assessment of Medical Biochemistry Concept Mapping: There are a total of three criteria yielding a possible 15 points. Each of the criteria is defined in the rubric. The BMS 680/BSCI 609 rubric used to evaluate this assignment will be based very closely on *University of Minnesota and Barbara Martinson’s evaluation rubric.*

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Excellent (5)</th>
<th>Very good (4)</th>
<th>Good(3)</th>
<th>Fair (2)</th>
<th>Poor (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structure</strong></td>
<td>Non-linear structure that provides a very complete picture of your ideas</td>
<td>Non-linear structure that provides a complete picture of your ideas</td>
<td>Non-linear structure that provides a picture of your ideas</td>
<td>Non-linear structure that shows some relationships between ideas</td>
<td>Inappropriate structure</td>
</tr>
<tr>
<td><strong>Relationship</strong></td>
<td>Importance of ideas is indicated and is both simple and complex</td>
<td>Relative importance of ideas is indicated and relationships are very effectively mapped</td>
<td>Relative importance of ideas is indicated relationships are mapped</td>
<td>Importance is evident but not very distinctive; relations are somewhat clear but lacking</td>
<td>No differentiation between ideas; no evidence of meaningful relationships</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>Information is Presented clearly and allows for a high level of understanding</td>
<td>Information is Presented clearly and allows for a good level of understanding</td>
<td>Information is presented clearly and allows for a basic level of understanding</td>
<td>Information is presented and some Understanding can be gained</td>
<td>Information is not clear, very difficult to understand</td>
</tr>
</tbody>
</table>

By Dr. Beaudry’s criteria: 3.5 on a scale of 5
Results

Case Quizzes, Concept Maps and Tests

Fig. 4. The average scores of different learning assessments upon introduction of the new curriculum.

We compared average scores of case quizzes, concept maps and tests in the first and second half of the course. There is a significant increase in the case quiz scores in the second half of the course. This indicates an improvement in understanding and retention of the course material.
Fig. 5. Distribution of biochemistry letter grades in classes 2009-2013. There is a noticeable improvement in student performance, especially after implementation of the new curriculum last year. The number of students earning “A” or “B” grade has increased, the number of those earning “C” has decreased and there were no failures for the first time since the inception of the school.
Conclusion

• Setting clear learning goals, connecting the teaching to assessment, and designing relevant assessment tools lead to better teaching and learning.

• Combining interactive lectures and clinical cases contributes significantly to the improvement of performance.

• Using concept mapping as a tool to visualize knowledge and a rubric to evaluate students’ products is critical in this process.

• By the end of the course, students are able to make very clear connections. This confirms Dr. Woods’ observation:
  – connections made by basic sciences’ faculty using clinical illustrations are more permanent than the temporary connections created by students to retain information based on rote memory.

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