Supplemental Material: “Concept Maps Used to Rehearse & Assess Students’ Synthesis of Course Content”

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Background - why use concept maps in 9.01/9.00

During Fall 2020 when all courses were virtual, the assessment structure of 9.01 included only multiple choice and short answer questions. This structure made it challenging for the course team to monitor for cheating and keep up with grading/feedback. During Fall 2021, quizzes were composed of only multiple-choice-like questions. However, students expressed that this left limited room for them to express their understanding. Laura Frawley therefore decided to experiment with using concept maps as an assessment tool during Fall 2022.
List of key terms for concept map on neural systems in 9.01

Note: We’ve included 2 subtopics that can be direct branches from your topic. We’ve placed terms related to each subtopic under the given subtopic.

**Topic: Neural Systems**

**Terms**

**Somatic sensation (subtopic)**
- A-beta
- A-delta
- Afferent regulation
- Brodmann’s area 3B
- C fibers
- Descending regulation
- Dorsal column medial lemniscal pathway
- Endorphins
- Gate theory of pain
- Homunculus
- Hyperalgesia
- Mechanoreceptors
- Nociception
- Nociceptors
- Opioid receptors
- Pain
- Primary afferent axons
- Spinothalamic pathway
- Temperature
- Thermoreceptors
- Touch
- Trigeminal Nerve pathway

**Motor system (subtopic)**
- Alpha motor neurons
- Basal ganglia
- Golgi tendon organs
- Lateral pathways
- Lower motor neurons
- Motor cortex
- Motor unit
- Muscle spindles
- Proprioception
- Reciprocal inhibition
- Ventromedial pathways
List of key terms for concept map on learning in 9.00

**Topic: Learning**

**Terms**

Classical conditioning
Contingency
EL Thorndike
Extinction
Extrinsic motivation
Fear conditioning
Generalization
Intrinsic motivation
Latent learning
Law of Effect
Operant conditioning
Pavlov
Reward value
Second order conditioning
Skinner
### Examples of Concept Map Errors

<table>
<thead>
<tr>
<th>Cognitive Development</th>
<th>Kohlberg’s Theory of Moral Development</th>
</tr>
</thead>
</table>

- 0.5: no linking phrase between “cognitive development” and “Kohlberg’s theory of moral development”.
- 0.5: I’m not fully convinced that “Kohlberg’s theory of moral development” and “cognitive development” should be linked together, though it’s reasonable moral judgements rely on cognitive development. Kohlberg’s theory of moral development is a psychological theory proposed by Lawrence Kohlberg in the 1950s and 1960s. They theory posits that people develop moral reasoning skills over time through a series of stages. Kohlberg’s theory is based on the idea that moral reasoning is an internal process that people go through as they try to make sense of moral issues and dilemmas. Alternatively, you could link Kohlberg’s theory of moral development directly to central term.”

### Examples of TA Feedback

<table>
<thead>
<tr>
<th>Nurture</th>
<th>Child Development</th>
<th>Nature</th>
</tr>
</thead>
</table>

- 0.5: Linking phrases between “nature”, “nurture” and “child development” are vague. Instead, nature refers to the genetic and biological factors that a child inherits from their parents. Nurture refers to the environmental factors that influence a child’s development, including parenting styles, culture, education, socio-economic status, and life experiences.”
<table>
<thead>
<tr>
<th>Examples of Concept Map Errors</th>
<th>Examples of TA Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brain</strong>&lt;br&gt; <em>Death of weak, useless neurons</em></td>
<td><strong>Synaptic Pruning</strong>&lt;br&gt;“-0.5 minor mistake (synaptic pruning refers to elimination of weak connections between neurons rather than the actual neurons themselves)”</td>
</tr>
<tr>
<td><strong>Classical conditioning</strong>&lt;br&gt; <em>Studied by Pavlov</em>&lt;br&gt; <em>Scientist who trained dogs to salivate due to a tone through</em></td>
<td><strong>Skinner</strong>&lt;br&gt;“-1 Classical conditioning was studied by Pavlov, not skinner -1 Pavlov didn’t use second order conditioning (since the conditioned stimulus was directly paired with the unconditioned stimulus)”</td>
</tr>
</tbody>
</table>
Results from student surveys in 9.01 and 9.00

From a student survey conducted for 9.01 at the end of Fall 2022:

<table>
<thead>
<tr>
<th>Survey Question</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating concept maps helped me see the big picture</td>
<td>13%</td>
<td>33%</td>
<td>50%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>Creating the concept map helped me visualize meaningful connections between concepts or terms</td>
<td>11%</td>
<td>31%</td>
<td>52%</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>I think the concept map is a helpful way to process information</td>
<td>46%</td>
<td>36%</td>
<td>11%</td>
<td>6%</td>
<td>1%</td>
</tr>
<tr>
<td>I recommend keeping the concept map as part of the quiz in future iterations of the course</td>
<td>33%</td>
<td>40%</td>
<td>17%</td>
<td>8%</td>
<td>2%</td>
</tr>
</tbody>
</table>

From a student survey conducted for 9.00 at the end of Spring 2023:

<table>
<thead>
<tr>
<th>Survey Question</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating concept maps helped me see the big picture</td>
<td>16%</td>
<td>22%</td>
<td>50%</td>
<td>12%</td>
<td>1%</td>
</tr>
<tr>
<td>Creating the concept map helped me visualize meaningful connections between concepts or terms</td>
<td>12%</td>
<td>24%</td>
<td>50%</td>
<td>10%</td>
<td>3%</td>
</tr>
<tr>
<td>I think the concept map is a helpful way to process information</td>
<td>44%</td>
<td>28%</td>
<td>14%</td>
<td>11%</td>
<td>3%</td>
</tr>
<tr>
<td>I recommend keeping the concept map as part of the remaining quizzes in the course</td>
<td>20%</td>
<td>37%</td>
<td>21%</td>
<td>19%</td>
<td>3%</td>
</tr>
</tbody>
</table>

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