Blunder lecture to reeducate physiology concepts by cognitive conflict strategy

Satendra Singh
Department of Physiology, University College of Medical Sciences, Delhi, India

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Every time we communicate, new concepts compete with preconceived ideas... All students hold these ideas, but are unaware of their private theories. We must make them aware. Only then can we enable them to learn, and free them from their private universe.

(From “A Private Universe,” an award-winning 1987 documentary by Sadler, Schneps, and Woll).

Our students are not a tabula rasa in classes. These varied learners imbibe new information in relevance to others and reaffirm their own concepts. Quite often, in this journey of forming new connections, inadvertently, misconceptions are retained and may be reinforced if not corrected early. Students come to learning situations with preconceived knowledge and understanding. A constructivist teacher uses this previous knowledge to act as a base for the new knowledge that the student will create.

One of the ways to induce this conceptual change is by inducing cognitive conflict. This instructional strategy comprises the presentation of anomalous data or contradictory information. The contrasting information stimulates students to formulate their own queries, allows them their own interpretations (reflection and synthesis of new knowledge), and encourages them to arrive at a correlation or conclusion in group work (collaborative learning). Here, I present my experience of introducing a blunder lecture in a large group of students to encourage them to test their conceptual frameworks through a cognitive conflict strategy.

METHODS

Design of the Blunder Lecture

I taught physiology of nerves and neuromuscular junctions to first-year Bachelor of Medicine and Bachelor of Surgery students. The content was covered in a block of five lectures. At the end of the unit, I gave a 30-min blunder lecture incorporating 25 misconceptions (hereafter known as “blunders”). A blunder lecture is a lecture where the lecturer deliberately makes blunders and students spot the blunders using their prior knowledge (3). One hundred two students were present that day, and they were divided into ten small groups. Students were asked to note down the blunders and work with their peers. At the end of the lecture, groups were asked to spot the deliberate blunders made in the lecture. Finally, all blunders were discussed and clarified.

A five-item questionnaire was given to each of the participants of the blunder lecture to gain their feedback.

The strategy involved was to challenge students’ already retained knowledge in a different way. The cognitive conflict paradigm involves presentation of anomalous data (cognitive conflict), its correlation with clinical knowledge (applied aspect), and collaborative learning with students to revisit and rectify concepts (group work and feedback). Twenty-five blunders were prepared to include all levels of the hierarchy in the cognitive domain of Bloom’s taxonomy. They ranged from knowledge, comprehension, and application at the lower levels to analysis, synthesis, and evaluation at the higher levels. Table 1 shows the blunders in terms of the respective level of Bloom’s taxonomy of the cognitive domain.

Since each student is unique and learns or relearns on his or her own, there was a danger of retaining the misconception. Fallacies need to be corrected by owners themselves. The aim was to confront learners with their own concepts (or misconceptions), make them attentive to revisit where they are lacking, and challenge them to rectify concepts/misconceptions with peer collaboration in planned small-group work. All misconceptions were cleared in the end, and students were further encouraged to contact me in case of any clarification. The blunder lecture was used here as a means to promote conceptual change with a view to promote active learning in large group teaching.

RESULTS AND DISCUSSION

Of 102 students, 82 students responded (80% response rate) to the five-item feedback, as shown in Table 2.

Student Feedback

What students liked. The majority of students believed that the inclusion of a blunder lecture reeducated their concepts (or misconceptions), as shown in Table 2. It helped them to revise the entire unit in an innovative way as well as clarified their doubts, as described by the following comments:

- Blunders help us to remember.
- It helped in recollection of the previous concepts and allowed a quick revision of previous classes.
- The concept is helpful in revising things and points out the frequent misconceptions and normal mistakes done by us.
- Checked what all we could retain even before opening the book.
- Put our knowledge to test & good exercise for recalling things.
- Helps in memorizing the points quickly.
- Our concepts are cleared by these types of lectures. (It) also motivates us to study and is more exciting than the exams.

Students found this exercise engrossing and the concept promoting active learning, as demonstrated by the following comments:

- It helped me in finding my learning needs.
- Learning is much more fun.
- I was not at all prepared for the topic but I recognized many errors.
Table 1. Misconceptions used in the blunder lecture

Knowledge
- Glial cells are the most common cellular element in the central nervous system, comprising four to five times the number of neurons.
- For myelinated nerve fibers, conduction velocity is two times the diameter.
- The axon hillock is the first portion of the axon.

Comprehension
- Orthograde transport is governed by dynein, and retrograde transport is governed by kinesin.
- The Erlanger and Gasser classification divides only sensory fibers into groups I–IV, whereas the Lloyd and Hunt classification divides all nerve fibers into groups A–C.
- Fibrous astrocytes are associated with nerve fibers (axons) and located in the white matter, whereas protoplasmic astrocytes are concentrated in the gray matter.
- Astrocytes maintain ionic balance by mopping Na$^+$ and glutamate or GABA.
- Oligodendrocytes are involved in myelin formation in the central nervous system and peripheral nervous system.
- Unipolar cells have no axons.

Application
- Neurofibrillary tangles are characteristically seen in multiple sclerosis.
- During low neuronal activity, astrocytes engage in glycogenolysis.
- Lambert–Eaton syndrome is an autoimmune disease where the body tends to destroy its own ACh receptors. When the axon is injured, a series of degenerative changes are seen at three levels: in the axon distal to the injury (retrograde), in the axon proximal to the injury (Wallerian), and in the cell body.
- Peripheral neuropathies are caused by mutation in Ca$^{2+}$ receptors.
- After reaching the resting membrane potential, the potential further falls. This positive afterpotential is termed “afterdepolarization,” and the negative afterpotential termed “afterhyperpolarization.”

Analysis
- Regeneration is primarily a function of the distal stump, but it succeeds only if the proximal segment provides an endoneurial sheath.
- The natural plant product neostigmine is used by Red Indians as an arrow poison.
- Nerve is more excitable than muscle because its chronaxie is directly proportional to excitability.
- A square-pulse stimulus fails to trigger action potential because of adaptation.

Denervation sensitivity is linked to downregulation of ACh receptors.

Synthesis
- Hypocalcemic tetany is the result of an increase in extracellular Ca$^{2+}$, which increases the excitability of nerve and muscle cells in vivo, leading to extensive spasms of skeletal muscles.
- When our finger gets hurt, we instinctively press it hard. This relieves the sharp, pricking pain that is conveyed by A$\gamma$-fibers.
- Neurotensin is the state of a cut perineurium but an intact endoneurium. Evaluation
- Calabar (ordeal) beans used as lie detectors by some native tribes, because they act as competitive inhibitors of B fibers, which are most susceptible to hypoxic block and responsible for Saturday night paralysis.
- Conduction by A fibers is easily blocked by LA. This is why after LA the more agonizing burning pain is blocked, but the sharp, pricking pain and touch conveyed by group C fibers may not be completely blocked. Hence, the patient may complain of feeling the movement of the knife but not agonizing pain.

LA, local anesthetics.

Students felt themselves to be more attentive in the blunder lecture, as described by the following comments:

Out of the box, kept me alert in the whole lecture.

In this concept, we are more focused to point out mistakes.

Students became more attentive in order to bring out flaws.

The process was seen as aiding students to prepare for their future postgraduate entrance examinations. It also helped in collaborative learning and team work, as described by the comment below:

It actually makes me feel good, gives a competitive environment.

Not only did the blunder lecture revise the content of the lectures, but it also informed students about the important material that they may have missed, as described by the following student comments:

Come to know about skipped topics.

Prevent us from missing out small but important topics.

Suggestions. A few of the students suggested that this concept should be announced well in advance so that they could come prepared. They also wanted all blunders to be put up in the concluding slide for them to reflect upon. Overall, students really enjoyed the process, and many suggested introducing the concept in other preclinical subjects as well, as described by the following comments:

Should happen after every unit.

Must happen in every subject; would like it better if these were in place of tests.

Other teachers should follow this.

Introduce as quiz competition.

Concerns. Before the exercise, even I was bit skeptical as to how students would take it. To be honest, I was expecting lot of concerns. To my utter surprise, almost all of them reported no concerns. They only wanted more of these in future. Only one student reported the following:

We may remember wrong things in exam.

But the same individual requested “more of these in future.” Another student wrote the following:

Help us in finding mistakes so that we don’t forget in future.

Table 2. Student perceptions of the blunder lecture

<table>
<thead>
<tr>
<th>Student Responses</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did you like the blunder lecture?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>81</td>
<td>99</td>
</tr>
<tr>
<td>What did you like about the concept?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revision and better retention of topics</td>
<td>34</td>
<td>41</td>
</tr>
<tr>
<td>Clarification of doubts</td>
<td>26</td>
<td>32</td>
</tr>
<tr>
<td>Student involvement/learning was fun/active learning</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>Innovative, outside-of-the-box concept</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>More attentive</td>
<td>14</td>
<td>17</td>
</tr>
<tr>
<td>Helpful for postgraduate entrance exams</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Teamwork</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Came to know about topics I missed</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>What are your concerns about the concept?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None/should be conducted more often</td>
<td>81</td>
<td>99</td>
</tr>
<tr>
<td>We may remember wrong things in the exam</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Do you want more of these in future lectures?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>82</td>
<td>100</td>
</tr>
<tr>
<td>Any suggestions?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Should happen after every unit</td>
<td>56</td>
<td>68</td>
</tr>
<tr>
<td>Must happen in every subject</td>
<td>32</td>
<td>39</td>
</tr>
<tr>
<td>Other teachers should follow this</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Would like it better if these were in place of tests</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Announce it well in advance</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Introduce it as a quiz competition</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

n, number of students (82 total student respondents, 80% response rate).
I assume two things favored this concept as more of a “reeducating” one than one creating doubts. The fact that I declared at the very beginning that I would deliberating be making mistakes set the tone that the purpose was to use deep thinking. Second, the exercise was deliberately kept at the end of the unit so there was no surprise inclusion of already taught concepts.

The Learning Experience

Student involvement in the classroom is the result of interactions between students and the instructional environment. Students have diverse learning needs. I tried to use cognitive conflict strategy to stimulate student inquiry, reflection, and collaborative learning. The very first roadblock in promoting active learning is to induce a meaningful cognitive conflict. Students should be motivated and interested in the topic at the very first place to activate their prior knowledge (1, 2). The introduction of anomalous data was a deliberate strategy to sustain student interest and provoke cognitive conflict.

The whole process was a learning curve as well as a satisfying experience. The initial hard work was in preparing the content of the lecture and using the deliberate errors in the higher domains of Bloom’s taxonomy so that deep learning was motivated. I prepared the blunders on my own, but it may be a good idea to ask for help from fellow colleagues to classify these types of misconceptions.

My own concerns of perpetuating misconceptions were largely unfounded in the student feedback. Moreover, I could not find students writing blunders (used for clarifying concepts in the classroom) into the first terminal written examination where a question addressed nerve and muscle physiology. I had no role in the framing of the question. By coincidence, the structured question asked about a few concepts that I tackled in my blunder lecture, as follows:

Describe the transmission of an impulse across the neuromuscular junction. Write the mechanism of action of any two neuromuscular blockers. Add a note on myasthenia gravis. (4 + 2 + 2 = 8 marks).

I could not find any reproduction of the blunders in the written test. This might be because all blunders were corrected in the class itself and an opportunity was provided to discuss the issues further. The same methodology has been used in anatomy and published in a previous study (3). In this study, the authors also did not find any negative influence of the concept.

Prakash (4) used a somewhat similar strategy where he challenged learners by declaring that his lectures are near perfect and with zero errors. The challenge posted to students’ ego motivated them to do an indepth study of the concepts to try and determine the errors, if any. The “perfect teacher” and his “zero defect” not only helped students but also assisted the educator in becoming a better teacher.

To use blunder lectures effectively, efforts should be made to challenge the reasoning abilities of students. Presentation of mere anomalous data will not be sufficient to lead to meaningful conflict. It is indeed a challenge for the educator to use higher cognitive domains in framing blunders and incorporate these into group work. However, this should be viewed as another opportunity to obtain insights into students’ understanding of the concepts that are covered in lectures. Four postgraduate students were also sitting in the lecture, and they also liked the concept and insisted on the utilization of the same strategy for postgraduate teaching.

My own experience, student feedback, and assessment results reinforce the notion that blunder lectures can achieve conceptual change through a cognitive conflict strategy.

REFERENCES