SiQuENC for science (prerequisite stage: formal operational)

<table>
<tr><th></th><th>Situation(s)</th><th>Quantity(ies)</th><th>(In)equation(s)</th><th>Analyze</th><th>Communicate (and compare)</th></tr>
<tr><td rowspan="8">1. Inquiry
(Propose and reject concepts about physical quantities and general relationships)</td><td>2. Aimlessly play with laboratory equipment for a while, then sketch the laboratory equipment available.</td><td>3. Propose and graphically represent quantities
(a) measured directly
(b) defined in terms of measured quantities</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>4a. Propose (A) some general relationship involving proposed quantities.</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>4b. Propose at least one (B) contradictory general relationship involving proposed quantities.</td></tr>
<tr><td>5. Sketch laboratory equipment configured to allow proposed relationships A and B to lead to testable predictions.</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>6a. Derive from proposed relationship A predictions that can be experimentally challenged.</td><td></td></tr>
<tr><td></td><td></td><td></td><td>6b. Derive from proposed relationship B predictions that can be experimentally challenged.</td><td></td></tr>
<tr><td></td><td>7. Graphically represent predictions obtained from relationships A and B using, if possible, common axes.</td><td></td><td></td><td></td></tr>
<tr><td>8. Perform experiments described in sketch(es) in step 5.</td><td>9. Graphically represent relationships obtained from experimental measurements on, if possible, axis system(s) used in step 7.</td><td></td><td></td><td>10. Paying attention to the graphical representations in step 9,
(a) State each predicted outcome and each observed outcome.
(b) State whether any particular prediction was contradicted by any observation(s).
(c) If a prediction is experimentally contradicted, speculate what aspects of the general relationships that led to that prediction might need to be rejected or revised.</td></tr>
<tr><td>11. Consolidation (making a cribsheet)</td><td colspan="5">By now, a bunch of SiQuENC forms have been filled out with laboratory data discussions.
12. Neatly copy surviving concepts onto fresh paper (still organized into columns for Si, Qu, E, N, and C).
13. Sometimes, you might want to copy a rejected proposed relationship because the rejection was so counterintuitive that the rejection might be easy to forget.</td></tr>
<tr><td>14. Problem-solving</td><td colspan="5">See D. Liao, “A SiQuENC for solving physics problems,” in press, vv, 264-265 (2018).</td></tr>
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