Assessing intensive writing assignments for mathematical programming content

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Teaching Computation in the Sciences using MATLAB Workshop 2019
Does writing in math courses help learning?

Questions as instructors:
• Is writing about mathematics (in full sentences) helpful to students?
• How can I measure their learning gains through writing and is it different than students submitting code only and final answers?
• Is automatically graded code enough?
Classroom Context

• Cal State Univ Channel Islands: Hispanic Serving Institution
• 2/3 Female Population; not seen in upper division courses w/ computing
• Introductory Numerical Analysis course fulfilling upper division GE
  • Traditional Math Content and programming corresponding algorithms
  • Read/write topics: historical numerics disasters, gender in computing, philosophical perspectives (US-western vs. Chinese-eastern in medicine)
• 24 students, scalable to some extent
  • math, CS, mechatronics, and applied physics majors (some chem) - seniors
• MATLAB Site License (one-year ago)
How do I assess their work?
# Grading Rubrics

**CORRECTNESS**

<table>
<thead>
<tr>
<th>4. Claims fully demonstrated with correct math logic</th>
<th>3. Claims demonstrated with minor logical gap and for incorrect statements</th>
<th>2. Claims partially supported with some correct logic</th>
<th>1. Claims not supported</th>
</tr>
</thead>
</table>

**COMPLETENESS**

| 2. Assignment features complete sentences and clear descriptions, including correct spelling, grammar, and notation. All components are complete | 1. Assignment uses sentence fragments with partial descriptions and/or proof is overly wordy and/or there are minor problems with spelling, grammar, and notation. Some missing components. | 0. Assignment is difficult to understand because of terrorseness and/or verboseness and/or severe problems with spelling, grammar, and notation. Several missing components. | 0. Assignment is difficult to understand because of terrorseness and/or verboseness and/or severe problems with spelling, grammar, and notation. Several missing components. |

**TECHNIQUE**

| 2. Technique clearly indicated and components of arguments and supporting figures are easily identifiable | 1. Technique and structure clear only after multiple readings | 0. Technique is unclear and/or structure is incorrect | 0. Technique is unclear and/or structure is incorrect |

**CLARITY**

| 2. Most students in this course would be able to read and understand this assignment or submission | 1. Some students could understand this assignment with careful reading | 0. Assignment is very difficult to follow and requires multiple readings to begin to understand. | 0. Assignment is very difficult to follow and requires multiple readings to begin to understand. |

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**Traits Assessed**

- New Learning, Connects &/or Challenges (10 points)
  - The writer demonstrates familiarity with and understanding of main ideas in all or almost all (80-100%) assigned texts/materials.
  - New learning is compellingly evident. New ideas are reinforced and/or challenged through connections to other assigned texts/materials, previous knowledge/content.

- Academic Writing (10 points)
  - Strong academic writing skills are evident:
    - The paper is content-rich and well structured (e.g., developed paragraphs, logically sequenced).
    - Specific and correct in-text citations are provided,
    - The writing is grammatically and mechanically flawless, or very nearly so.

- Correctness (10 points)
  - Correctness (10 points)
  - Technique & Clarity (5pts)
  - This includes any code implementation

**Consistent Evidence 8-10 points**

- The writer demonstrates familiarity with and understanding of main ideas in all or almost all (80-100%) assigned texts/materials.
- New learning is compellingly evident. New ideas are reinforced and/or challenged through connections to other assigned texts/materials, previous knowledge/content.

**Some Evidence 5-7 points**

- The writer demonstrates familiarity with and accurate understanding of main ideas in most (60-75%) assigned texts/materials.
- New learning is evident, but connections between texts or previous knowledge/content are not provided.

**Insufficient Evidence 0-4 points**

- It is unclear if assigned texts were read and/or understood and/or there is no evidence of familiarity with content from the required text.
- Little to no new learning is described.

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*Rubrics designed in collaboration with Drs. Kaia Tollefson, Kathryn Leonard, Geoff Buhl, and Marie Francois*
Student #2 is progressing in the course in an average way. Rubric provides feedback and areas of improvement.

(different assignment)
Student #1 continues to excel throughout the course, rubric provides feedback on areas to improve.

<table>
<thead>
<tr>
<th>Objective</th>
<th>Correctness</th>
<th>Code &amp; Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2.5</td>
<td>4/4</td>
<td></td>
</tr>
<tr>
<td>2.2.8</td>
<td>4/4</td>
<td>careful w/ necessary vs. sufficient</td>
</tr>
<tr>
<td>2.2.16</td>
<td>4/4</td>
<td></td>
</tr>
</tbody>
</table>

Rubric scores:
- §2.2 #5, 8, 16
- §2.3 #5, 6, 15

Final score: 10/10
Next Level Considerations

• Mastery Based Grading: Allowing students to re-write their work until they have mastered the learning outcome
• Adapting the work to newly available tools: Grader & Live Scripts