Integrating Projects In Liberal Arts Math Courses

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Math Pathways Placement and Progression
Plan for implementation

Tech Pathway
- MATH 122 Technical Mathematics
- Foundations

OR Pathway
- MATH 123 Quantitative Reasoning
- MATH 080

STEM Pathway
- MATH 135, 136, 137

- MATH 100 Intermediate Algebra
- MATH 028 Essentials of Algebra I

CLM* Score
EALG** Score
Diagnostic Score

Below ability to benefit – refer to local adult education

CHANGING LIVES

IVY TECH COMMUNITY COLLEGE
Why Projects?

Another Assessment Tool:

- Not timed
- More integrated and complex
- Opportunity to communicate with mathematics
- Problem Solving
- Creative outlet
- Process of drafts and revisions
Why Projects?

Connections:
- Applications to job and “real” life
- Opportunity for “Ah ha” moments
- Use other resources
- Collaboration
Why Projects?

Group input:
- Practice writing skills/ Excel or other skills
- Put more of self into it
- Encourages research
- Way to show different skills
- Helps to make life decisions
- Real life practical application
Why Projects?

Group input:
- Helping them to think quantitatively
- “I’m really going to use this”
- Can provide choices
- Personalize
- Hard to cheat
- Make a connection to community
Challenges

- Open ended problems can be difficult to grade
- Open to interpretation by students and teachers
- Managing appropriate student resources
- Online searches can lead in wrong direction
- Answers may be available on the internet
- Distinguishing between collaboration and cheating
Challenges

Group Input:

- Writing clear enough to get right answer, but not too restrictive.
- How to give an example without students repeating
- Time consuming
- Students repeating the course
- Creating new projects
- Collaborating with other instructors
- Supporting adjuncts
Ways to Support:

- Share examples, grade as a class
- Model excellence
- Provide feedback on rough drafts
- Project checklist
- Writing support document
- Videos
- *Co-requisite course support
Ways to Support:

Group Input:
- Require a personal meeting
- Check points
- Utilizing library resources
- Create a cover sheet with expectations
- Extra “quiz” on project questions
Sample Projects:

F:\Math 123\Project Examples
Grading Rubrics:

F:\Math 123\Projects
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The Assignment:

Below are student responses to: Million Dollar Job – Would it be physically possible to take $1,000,000 in cash? Come up with a convincing argument as to whether this would be possible or not. Write a minimum one page explanation using complete and grammatically correct sentences and include diagrams, calculations, formulas, tables as necessary. Follow the syllabus guidelines for written work. Reminder: This assignment will be graded using the rubric in the syllabus.

Example 1:

Nowadays, you don’t see very much cash. Normally, personal assets and wealth are streamlined into a bank account. There are a variety of reasons as to why so many people are ditching traditional currency in lieu of electronic vaults. The most glaring and obvious reason is the safety and security that comes along with depositing in the bank.

But we’ve all seen movies (typically from the 80’s) that utilize a black briefcase packed with stacks of hundred dollar bills.

Let’s say all the bills are grouped in bundles of $1,000. In each of those bundles are 10 bills. Just because a $100 dollar bill is worth more than a $1 dollar bill doesn’t mean they both don’t look the same stacked. So in the suitcase, there would be 1,000 bundles, bundles comprised of $1,000.

Now I have no idea why anyone would have a briefcase packed with Benjamins, but given the crazy nature.

Example 2:

The easiest scenario that I could come up with for taking $1,000,000 is if you took 10,000 $100 bills. The way I calculated how many $100 bills you would need to take is by figuring out how many $100 bills there are in $1,000,000. I figured out the number by dividing 1,000,000 by 100. The answer to this calculation was 10,000.

Taking 10,000 $100 bills would take quite some time. It would be fairly simple if there were large quantities of $100 bill in bags. I figured if we got 5 bags that each contain 2,000 $100 bills then we would have one million dollars. I calculated how many bags we would need by dividing 10,000 by 2,000. This gave me the number 5. Therefore we need 5 bags that each contain 2,000 $100 bills in order to have one million dollars.
Example 3:

In order to decide if it is possible to move $1 million dollars, it is necessary to determine if it is physically feasible to move $1 million dollars. The following tables provide the information necessary to develop a realistic conclusion.

Table 1: Information Constants

<table>
<thead>
<tr>
<th>Approximate weight in grams</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of grams per pound</td>
<td>454</td>
</tr>
<tr>
<td>Bill thickness (in inches)</td>
<td>0.0043</td>
</tr>
<tr>
<td># of bills in a 1’’ stack</td>
<td>233</td>
</tr>
<tr>
<td>Bill length (in inches)</td>
<td>6.14</td>
</tr>
<tr>
<td>Bill width (in inches)</td>
<td>2.61</td>
</tr>
<tr>
<td>Carry-on Length (in inches)</td>
<td>22</td>
</tr>
<tr>
<td>Carry-on Width (in inches)</td>
<td>14</td>
</tr>
<tr>
<td>Carry-on depth (in inches)</td>
<td>9</td>
</tr>
<tr>
<td>Number of 9’’ stacks per carry-on</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 2: Bill Denomination Variables

<table>
<thead>
<tr>
<th>Denomination</th>
<th>$value /pound</th>
<th>Total pounds / $1 million</th>
<th>Approximate # of 9’’ stacks</th>
<th>Approximate # carry-ons required</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1</td>
<td>$454</td>
<td>2202.6</td>
<td>476.9</td>
<td>32</td>
</tr>
<tr>
<td>$5</td>
<td>$2,270</td>
<td>440.5</td>
<td>95.4</td>
<td>6</td>
</tr>
<tr>
<td>$20</td>
<td>$9,080</td>
<td>110.1</td>
<td>23.8</td>
<td>2</td>
</tr>
<tr>
<td>$100</td>
<td>$45,400</td>
<td>22.0</td>
<td>4.8</td>
<td>Less than 1</td>
</tr>
</tbody>
</table>

- It would be physically impossible for one person to steal $1 million dollars in $5 bills; however, three people could move two carry-ons each.
- Stealing $1 million $10 bills would require two people to manage the three carry-ons necessary.
- It would require only one individual to move $1 million in $20, $50, and $100 bills....

The easiest, most feasible method of stealing $1 million would be in bill denominations of $100. In this denomination, the total haul would weigh approximately 22 pounds and would be able to be carried in a satchel or backpack....
## Sample Rubric for general problem solving tasks

<table>
<thead>
<tr>
<th></th>
<th>Level 0-1</th>
<th>Level 2-3</th>
<th>Level 4-5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solving the Problem</strong></td>
<td>Did not understand the problem and/or didn’t show any work.</td>
<td>Understood the problem well enough to solve the task.</td>
<td>Solved the task and showed evidence that verified the answer.</td>
</tr>
<tr>
<td><strong>Degree of Sophistication</strong></td>
<td>Little or no attempt was made to actively explore the solution method.</td>
<td>A systematic approach was used that will produce a correct answer.</td>
<td>Solution method is efficient, and/or elegant and demonstrates mathematical sophistication.</td>
</tr>
<tr>
<td><strong>Representations</strong></td>
<td>Did not use any representations such as tables, diagrams, equations, organized lists, etc., to help explain the solution.</td>
<td>Made appropriate representations to help solve the task or help explain the solution, but more organization or explanation was needed.</td>
<td>Used appropriate and correct representations to solve the task.</td>
</tr>
<tr>
<td><strong>Presentation</strong></td>
<td>The presentation of the solution and reasoning was unclear to others.</td>
<td>The presentation of the solution was clear in most places, but others may have trouble understanding parts of it.</td>
<td>The presentation of the solution is clear and can be understood by others.</td>
</tr>
<tr>
<td>Points</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>-------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Mastery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Conceptual Mastery with minor quantitative error</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Conceptual Mastery with minor reasoning error</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Attempt with multiple correct quantitative or reasoning findings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Attempt with conceptual errors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Attempt with no conceptual knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Blank</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Example of a Grading Rubric for a Term Paper in Any Discipline

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure</td>
<td>The introduction clearly outlines the purpose, background, and scope of the study.</td>
<td>10</td>
</tr>
<tr>
<td>Organization</td>
<td>The paper is well-organized, with each section clearly defined and logically connected.</td>
<td>15</td>
</tr>
<tr>
<td>Research</td>
<td>The author has conducted thorough research, and the sources are credible and up-to-date.</td>
<td>20</td>
</tr>
<tr>
<td>Analysis</td>
<td>The analysis is clear and supported by evidence, and the conclusions are well-supported.</td>
<td>15</td>
</tr>
<tr>
<td>Presentation</td>
<td>The paper is professionally formatted, with appropriate headings, citations, and references.</td>
<td>10</td>
</tr>
<tr>
<td>Clarity of Thought</td>
<td>The writer demonstrates a clear understanding of the topic and presents ideas logically.</td>
<td>10</td>
</tr>
</tbody>
</table>

Criteria for grading:

- 90-100: Exceptional
- 80-89: Excellent
- 70-79: Good
- 60-69: Satisfactory
- 50-59: Marginal
- 0-49: Poor