The Impact of Cooperative Guided Reflection on Student Learning: The Case of Optimization Problem Solving in Calculus I

Kathy Tomlinson, University of Wisconsin—River Falls, Mathematics Department

Value of Cooperative Work in Mathematics

Students use CGR to reflect on the value of working with classmates to learn mathematics.

“With this group, we worked very well together to get the answer.”

“Only Max in our group had this one done and I relied very much on him to help me get through this one.”

“This problem was difficult for me, but with the help of my group, I got it figured out.”

CGR as an Aid in Knowledge Transfer

Students transferred knowledge of problem solving in calculus optimization to problem solving in an algebra setting. Student writing indicates that CGR is instrumental in this knowledge transfer.

“This problem taught me a lot about labeling the picture to make it easier to work out. When I labeled it the easy way, finding the derivative was much easier.”

“You have to get the (y-x) and the (y-β) before you can even start the problem.”

“Since I received help on number 16, I didn’t need help on this one, being as the concepts were the same.”

Conclusions

Through CGR students reflect on how much time they need to solve mathematics word problems, even though time is not addressed directly in the assignment.

“It definitely takes time to get your head around the information.”

“We learned that we need to take our time when we looked back and found some simple multiplication mistakes.”

“I have come to believe that of the problems I do, there are no hard problems, just long problems.”

Verbal, Graphical, Algebraic and Numerical Approaches to Calculus

Student writing demonstrates that CGR aids student growth in all four approaches to calculus.

“This problem involved a lot of numerical thinking, and as with most of the problems, verbal thinking as a group.”

“Richard explained to us that we needed to then take those numbers and place them into the equations of the sides. We did a lot of our thinking verbally for this problem.”

Exam Score Comparison with non-CGR students

<table>
<thead>
<tr>
<th></th>
<th>CGR students — two sections of Calculus I instructed by the investigator (N=26 and N=25)</th>
<th>Non-CGR students — one section of Calculus I with a different instructor (N=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Hour Exam Test Item</td>
<td>mean score: 9.6/15 points†</td>
<td>mean score: 8.9/15 points**</td>
</tr>
<tr>
<td>Common Final Exam Test Item</td>
<td>mean score: 9.2/15 points†</td>
<td>mean score: 9.0/15 points**</td>
</tr>
<tr>
<td>Students attending to minor issues: domain of function and test of critical number</td>
<td>38%</td>
<td>0%</td>
</tr>
</tbody>
</table>

*Not a statistically significant difference (p=.29)

**Not a statistically significant difference (p=.18)