

# The Effect of Ranking Tasks and Peer Instruction in a Mathematics Classroom

## Background

In order to prepare students for an ever-evolving technological workplace, the importance of Science, Technology, Engineering and Mathematics (STEM) education has never been greater. A common difficulty among students of all backgrounds is grasping and applying the correct conceptual understanding within any STEM discipline.

Ranking tasks are a type of formative assessment that has been found effective in increasing student conceptual understanding in some STEM disciplines (O’Kuma, Maloney, & Hieggelke, 2000). Conceptual understanding has also been demonstrated to increase when a collaborative peer instruction model is applied in the classroom (Crouch & Mazur, 2001).

The focus of this study is to determine the effectiveness of using ranking tasks collaboratively in order to improve student conceptual understanding. This study was undertaken at Okanagan Mission Secondary School in Kelowna, British Columbia, Canada. The participants were comprised of a Math 9 Honors class during a unit on linear relations.

## What is a Ranking Task?

Ranking tasks begin with a brief description. The description includes constraints, the basis for making an arrangement, and a pictorial representation of the options to rank. In addition, they also contain a form to rank the options, a space for an explanation, and a confidence level form (O’Kuma, Maloney, & Hieggelke, 2000).

Ranking tasks can be a pencil and paper exercise or potentially enhanced with Java-based Physlet and other software applications (Cox, Belloni, & Christian, 2005). Ranking tasks were initially designed with physics in mind. However, recent implementations in astronomy suggest ranking tasks could be an asset for all disciplines within STEM (Hudgins et al., 2007).

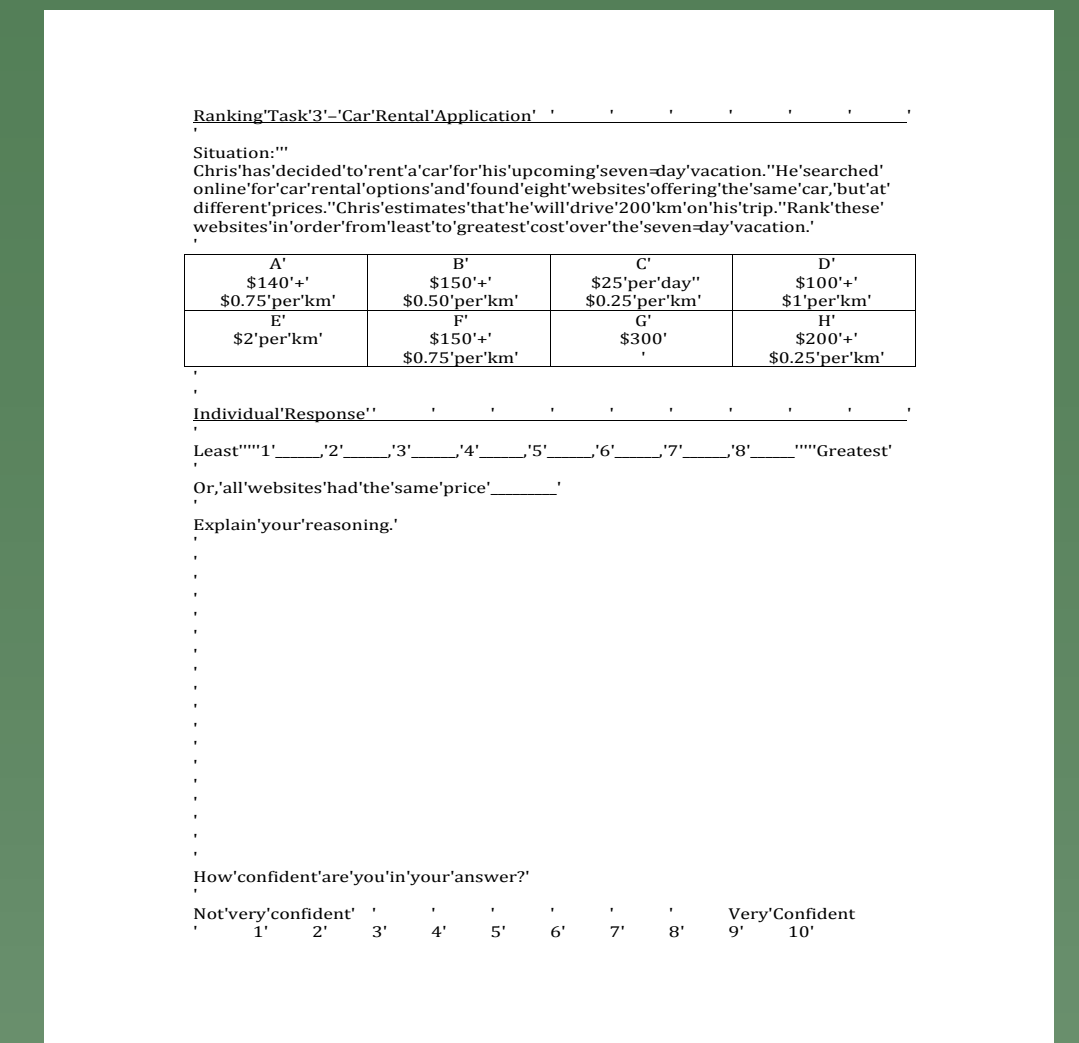


Figure 1. Ranking Task 3. (R. Harvey)

Research Questions	Data Collection Instruments
<b>Focus Question</b> Will the use of mathematics-based ranking tasks in a peer instruction environment increase conceptual understanding in high-school students?	Pre- and Post Linear Relations Concept Test (treatment unit), Pre- and Post-Equations and Inequalities Concept Test (non-treatment unit), Linear Relations Questionnaire, Linear Relations Student Interviews, Ranking Task Activities
<b>Secondary Question</b> Does a peer instruction environment enhance the use of ranking tasks by increasing student understanding, attitudes, and confidence?	Linear Relations Questionnaire, Linear Relations Student Interviews, Ranking Task Activities

## Methodology

The treatment for this study was structured around nine Ranking Task Activities (RTAs) that were completed over the course of a unit on linear relations. Each RTA had three distinct phases: individual response, peer discussion and response, and whole class debriefing.

The individual response section of each RTA typically took students up to ten minutes to complete. In the individual response section students were required to create and explain their ranking as well as indicate their confidence on a ten-point scale.

Students were then randomly selected in to groups of three or four in order to facilitate a small group discussion on their rankings. The intention of this collaborative phase was to have students verbally explain their thought process, listen and engage with others, and provide the opportunity for students to use argumentation to solve the problem. By the end of the collaborative phase, students re-completed the task. If they changed their answer they were asked to provide a reason as to why they made the change. The last phase of each RTA included a whole class debriefing on possible rankings and rationales.

Data collection included student interviews, a questionnaire, and the performance and confidence levels from the RTAs themselves. Also included were pre- and post-treatment unit tests. In addition, a pre- and post-test for a non-treatment unit was also administered for the purposes of comparison.

## Results

The results of this study suggested that collaborative mathematics-based ranking tasks can benefit student understanding of mathematics concepts. This was evidenced by the following results:

- Increased performance and confidence on collaborative completion of ranking tasks (Figure 2).
- Demonstrated gains in student achievement on the post-unit test compared to the pre-unit test (Figure 3). Gains for the treatment unit were also found to be higher than the non-treatment unit.
- Student interview and questionnaire results that were supportive of the effectiveness of ranking tasks, especially the collaborative aspect.

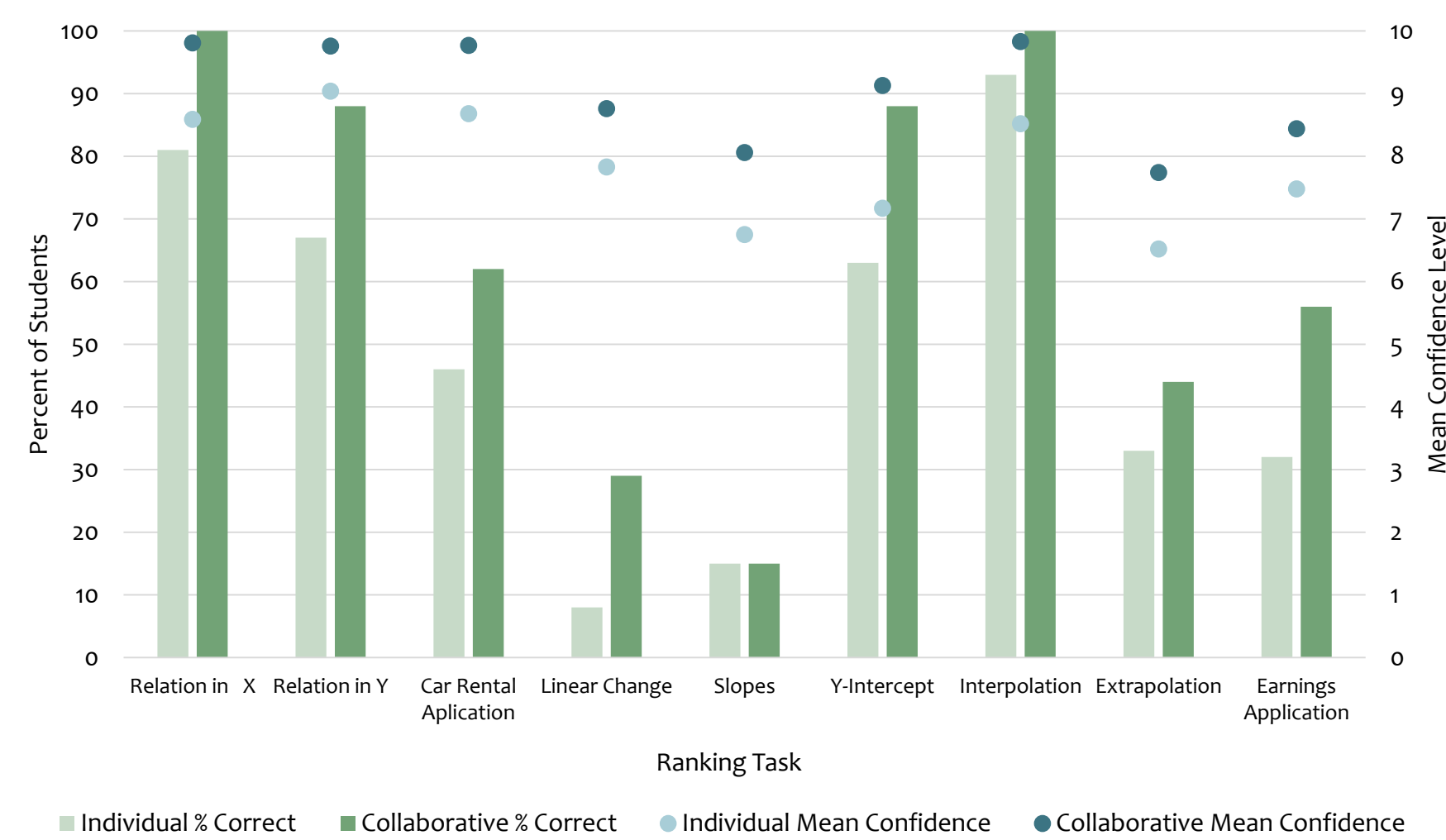


Figure 2. Initial and final correct student responses and confidence levels for nine Ranking Task Activities, (N=28). (R. Harvey)

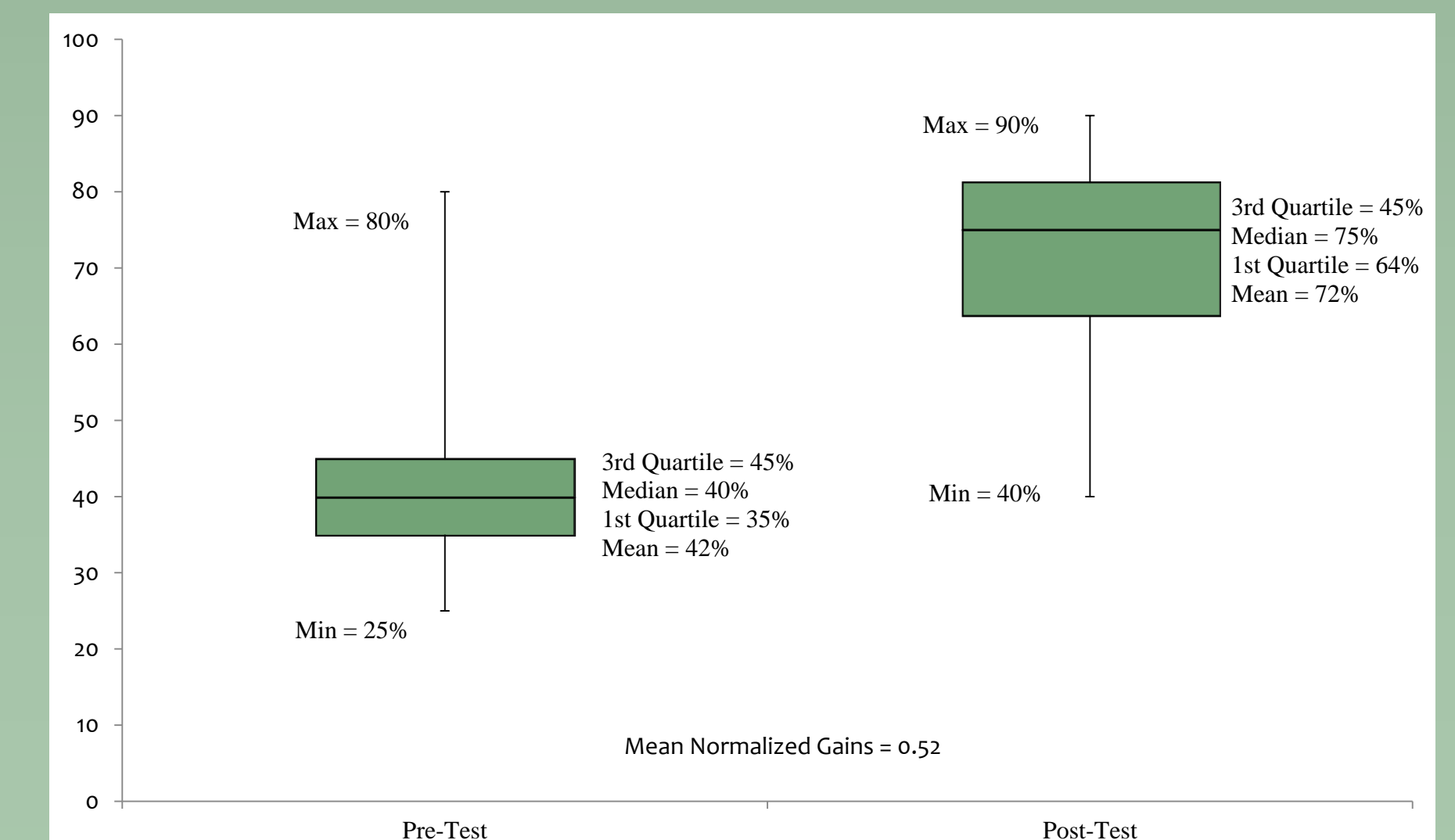


Figure 3. Box plot of pre-test and post-test Linear Relations Concept Test, (N=28). (R. Harvey)



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