DATA SCIENCE EDUCATION K-12

INDIVIDUAL PAPER: Middle School Students' Attitude and Self-efficacy Changes Towards Data and English Language Arts Following Instructional Integration

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Session Description

This study investigates the impact of co-designed data/literary literacy integrations on middle school students' attitudes and self-efficacy toward data and English Language Arts (ELA). The research team collaborated with teachers to develop activities where class texts were represented with data visualizations that two partner ELA teachers could use throughout the academic year. Using a modified version of the STEM Semantics and Career Interest instruments, we observed changes in attitudes and self-efficacy with respect to data for experimental groups and decreases for a control group. There were also some increases in attitudes about ELA in the experimental classes. While there are some limits to generalizability, these findings are encouraging for efforts for efforts to integrate data literacy with other disciplines in minimally-intrusive ways.

Objective

With increased attention to teaching data science across the disciplines (Jiang et al., 2022), little is yet known about what impact it might have on students with respect to their understandings or feelings about data science and the integrated discipline. As part of a larger iterative co-design project with middle-grade English Language Arts educators (NSF Grant no: 2241483), we have been developing strategies and instructional resources for combining literary literacy and data literacy in classroom instruction. Following a first year of full enactment with two middle school teachers, we offer preliminary findings from student survey data.

Perspective

This investigation focuses on attitudes and self-efficacy. Specifically, we are interested in how youth perceive activities involving English Language Arts and activities involving data and whether these are seen more or less favorably at the beginning and end of an academic year. Middle school is often understood as a period of time when STEM-related interest decreases (Osborne et al., 2003, Potvin & Hasni, 2014). However, new ways of encountering ideas or practices may shift how students view the fields and their relationships to those subjects.

Methods

With the support of a district partner, we conducted a quasi-experiment pre-post survey study with a middle-grade student population. The district identifies as urban with 68% Hispanic/Latinx, and 22% White student population with 52% qualifying for free or reduced-price lunch. Based on teacher availability, we had one experimental class of 6th grade students (taught by teacher T1) and two 7th grade classes at a magnet school that required admissions testing, comprised of primarily White and Asian students (taught by teacher T2). A control group of 7th grade classes selected by district partners of undisclosed demographic composition also participated. Data were obtained by the district and shared without identifiers with the researchers.

Teachers T1 and T2 participated in co-design of ELA and data literacy integration activities on a monthly basis with the research team and led all instruction themselves. Roughly a half dozen occasions throughout the year, data activities that involved examining features of text through visualizations – such as through visualizations that showed differences in word frequency across chapters, sentence length, commonly associated verbs or adjectives for characters – were introduced both before and after reading an assigned class text.

The 16 survey items were adapted from the STEM Semantics and Career Interest instruments (Tyler-Wood et al., 2010) but modified in wording to focus on data or English language arts rather than a specific STEM subject. At the start of the survey, administered online, students were given text "In the next section, we will ask you about data. Data include things like graphs, charts, and word clouds that give you information. See some examples below" and the image shown in Figure 1.

Examples of data in different forms like graphs, charts, and word clouds.

Figure 1. Image shown to students at beginning of survey to express what was referenced in survey questions regarding data.

We conducted paired T-tests across two district-classified gender groups on students' initial survey responses (collected in October of 2023) and post responses (collected in May of 2024). We did not have access to individual-level information about students besides their responses, gender, grade level, and grouping (control, T1, or T2). Video observations of at least three data literacy activities from T1 and T2's classes were collected by the research team and are undergoing analysis. Interviews of students before and after instruction which examine knowledge changes (Coelho et al., 2024) were collected and are undergoing separate analysis. This study focuses only on survey items related to attitudes and self-efficacy from our modified instrumentation. Only the items discussed in results are summarized in Table 1.

Table 1. Items discussed in results.

Category	Item Label	Item Text	Item Type
Data	DATA-INTERESTING	To me, working with data is [boring] vs. [interesting]	7-point Semantic Differential Scale
Data	DATA-CLASSWORK	I like to use data for classwork	7-point Likert Scale
Data	DATA-COMPLETE	I am able to complete activities that involve data	7-point Likert Scale
Data	DATA-SUCCESS	I feel successful doing activities that involve data	7-point Likert Scale
Data	DATA-JOB-USE	I see myself using data in my future job	7-point Likert Scale
Data	DATA-MANY-JOBS	If I learn a lot about data, I will be able to do lots of different types of jobs	7-point Likert Scale
ELA	ELA-READING	I like reading about stories/narratives	7-point Likert Scale
ELA	ELA-CLASS-READING	I like when my class reads or writes stories	7-point Likert Scale
ELA	ELA-FEELING	I understand how authors make you feel a certain way when you read	7-point Likert Scale

Results

In the control group. female students showed a significant decrease (alpha = 0.05) on three items that related to attitudes and self-efficacy regarding data (DATA-INTERESTING; DATA-COMPLETE; DATA-SUCCESS). Males in the control group showed a significant decrease on one item (DATA-SUCCESS).

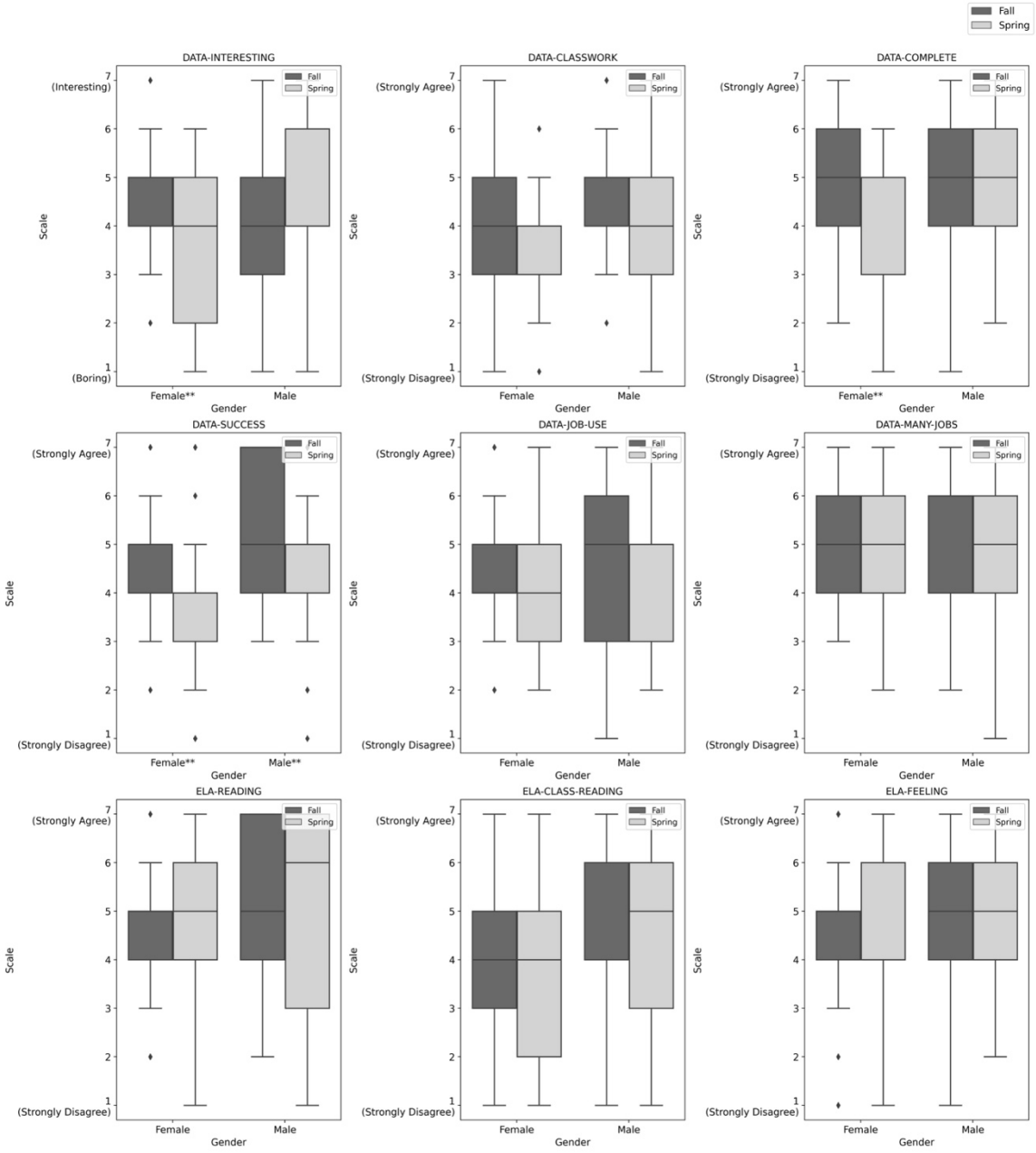

Figure 2. Fall and spring survey results comparison for control group (N = 50, 25 female students). The x-axis labels with "**" indicate statistical significance ($p < 0.05$) determined by a two-sample paired t-test.

In T1, female students had significant increases on two data items (DATA-COMPLETE; DATA-MANY-JOBS). Males had significant increase on three ELA items (ELA-READING; ELA-CLASSREADING; ELA-FEELING). No other items for were significantly different at our selected alpha level for these groups.

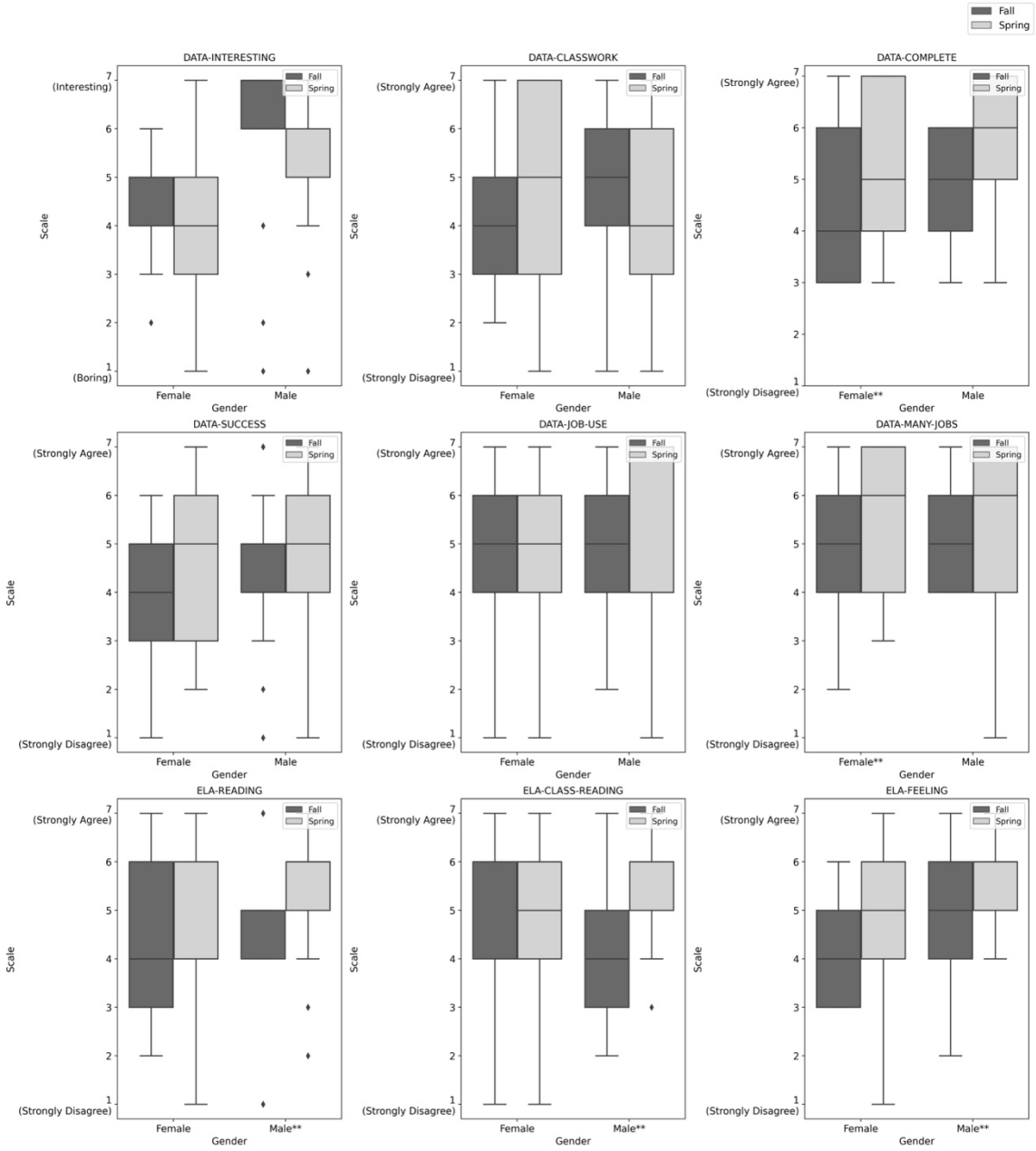

Figure 3. Fall and spring survey results comparison for T1 group (N = 34, 17 female students, 17 male students). The x-axis labels with "**" indicate statistical significance determined by a two-sample paired t-test.

In T2, female students had significant increases on one data item (DATA-JOB-USE). For ELA items, females had significant increase for one item (ELA-CLASSREADING). For males, there was significant increase on two data items (DATA-JOB-USE; DATA-COMPLETE) and no change on ELA items.

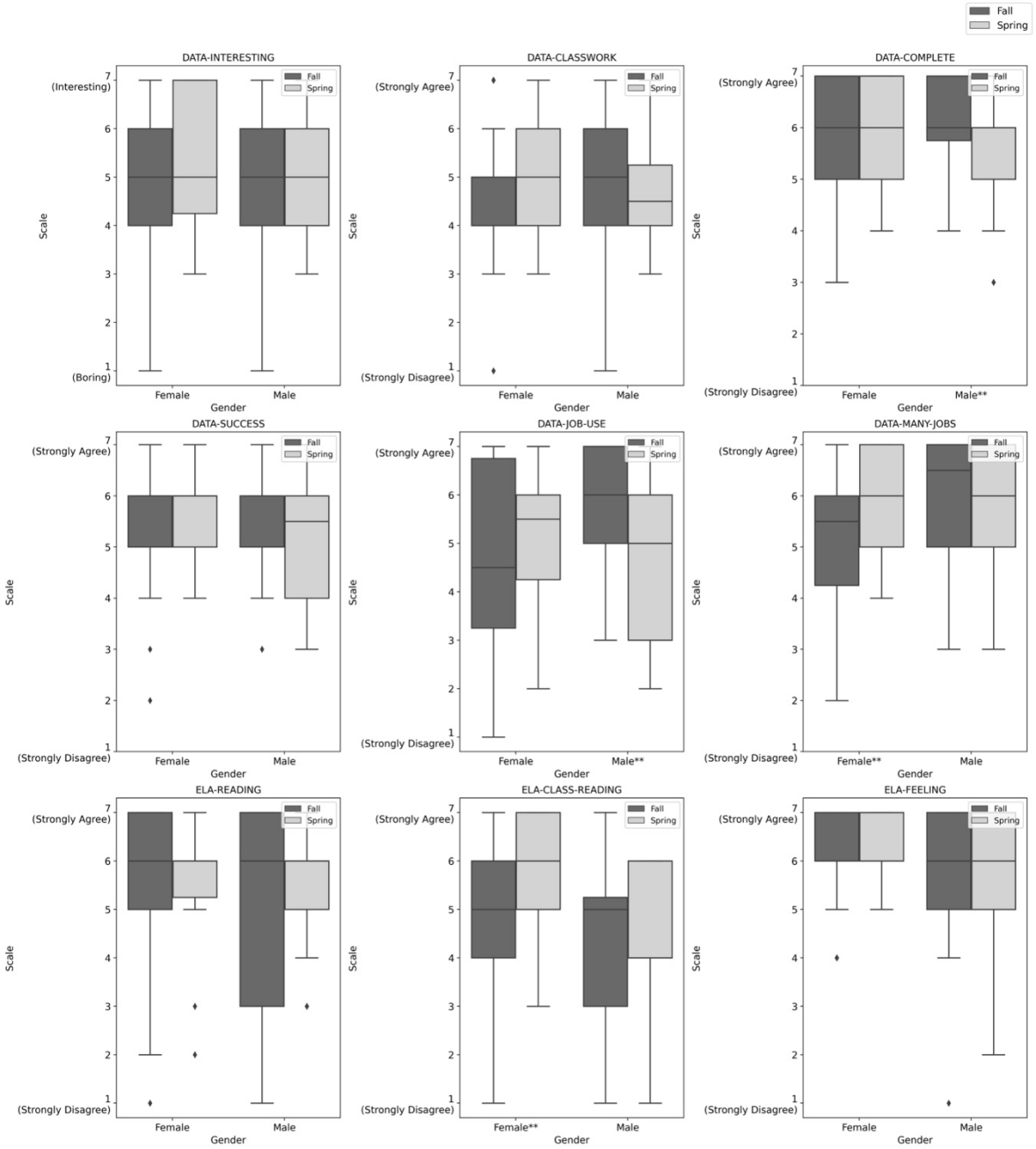

Figure 4. Fall and spring survey results comparison for T2 group (N = 46, 22 female students, 24 male students). The x-axis labels with "**" indicate statistical significance determined by a two-sample paired t-test.

Discussion

Initial results suggest that for female students, this approach has the potential to improve attitudes and self-efficacy for data. Absent this approach, control data suggests these would otherwise decrease. For some males, this approach may increase positive sentiments toward ELA. However, we recognize there are inherent limits that come from the quasi-experimental design and participant selection. More work will be needed, although the results suggest this integrative approach which was quite modest in scope and time commitment has potential for changing how students view data and their school subject matter.

References

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