Girls' Engagement in Science: Exploring the Influence of Gender Grouping in a Design-Based Science Context in a High School Biology Class

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Research Question: Does gender grouping (single-gender groups vs. mixed-gender groups) in small group work have an influence on female students' engagement in science in a design-based learning context in a high school biology class?

Background

Gender gap in science. In 2009, 24% of scientists and engineers in the USA were female.

What do we do? A common understanding: to increase K-12 female students' interest, participation and engagement in STEM subjects.

Why small group work? Promotes an equitable environment for girls' learning in science; has a positive impact on their persistence in science and other quantitative disciplines (e.g., Koch, 2002).

Why gender grouping?
Girls intimidated by the presence of boys and feel restricted in participation (Campbell & Evans, 1997).
Enhances girls' participation, engagement and achievement in STEM fields (e.g., Riordan, 1990).

Why design-based science?
Engineering design gained the same status as scientific inquiry (NGSS, 2013).
A different learning context (particularly for girls): people-oriented, highly relevant to life, social values.

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Conceptual Framework

Engineering Design

Design-Based Science: A science pedagogy where students work in groups to construct new scientific knowledge and problem-solving skills in the context of designing artifacts.

Student Engagement: behavioral, emotional, cognitive (Fredricks et al., 2004).

Factors Influencing Student Engagement:
Self-processes model applied to educational settings (Appleton, Christenson & Furlong, 2008).

Lit Review & Necessity of This Study

Much more studies at the school, classroom and pair levels than at the small group levels.
Most studies in math and science, few in DBS.
Mixed findings in math and science: gender grouping --> increased levels of girls' engagement and achievement; no correlation; reversed findings.
This study: small group (4 members) + DBS

Data Collection

Participants: eight high school students in a biology class. G1: 4 girls; G2: 3 girls + 1 boy
Context: designing a artificial heart valve
Data: whole process videotaped; focus group interviews

Data Analysis and Results

Sequence analysis:
Video watched in 2-min segments (sequences) and compared with pre-determined codes.
Alphabet of states:
1 - all engaged; 2 - majority engaged
3 - minority engaged; 4 - none engaged
Each sequence possesses only 1 state at a point in time for a given type of engagement
Optimal Matching in R: dissimilarity between 2 sequences calculated by the number of operations needed to make 2 sequences look the same.
Comparison between: G1 and G3 (all the 3 girls in G2)

Discussion

Boy in G2 made a significant difference – the main designer on whom girls relied.
Friendship played an important role in all 3 types of engagement.

Future Research
A much larger scale.
Girls’ college and career readiness (content + science & engineering skills)
Influence of DBS + gender grouping