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Influence of STEM Identity on Computational Design Thinking

[1]Andrew Walton, [2]Stephanie Bunt, [2]Laura Hinkle, [2]Dr. Nathan Brown

[1]Upper Moreland School District, [2]Department of Architectural Engineering, Penn State University

INTRODUCTION

The focus of this research is to explore how STEM backgrounds impact computational design thinking. We evaluate the following research questions:

- *Do STEM and non-STEM participants show notably different priorities in design?*
- *Do STEM and non-STEM participants show notably different performance in design, as measured by building performance "simulations"?*

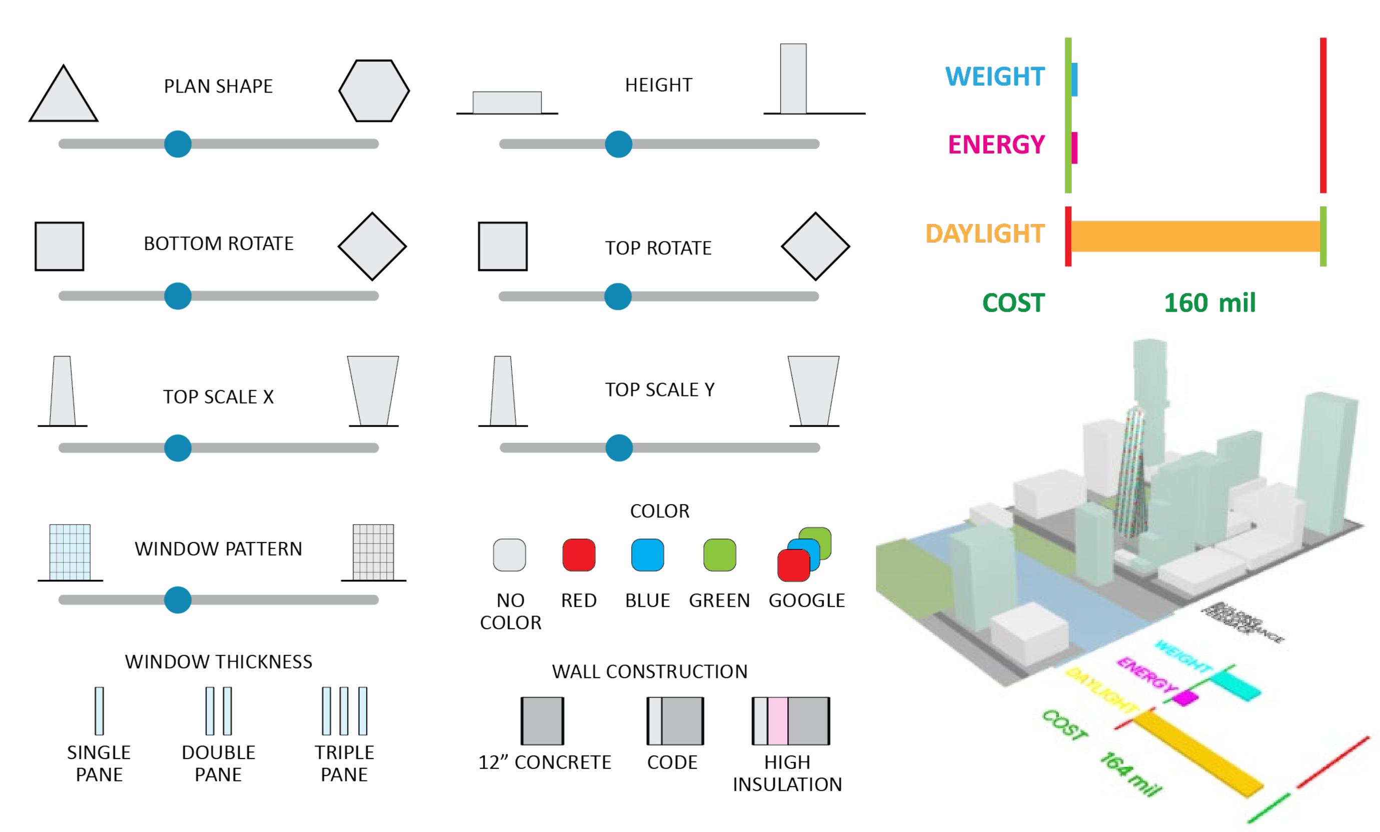
While previous research has focused on how computational thinking impacts student learning, this study goal was to explore different thinkers interact with models and the design process.

METHODOLOGY AND PROCEDURES

*The study included surveys to label 8 participants as **STEM focused (SF) or Non-STEM focused (NSF)**, and then an open-ended design challenge to record how participants engaged with typical building design objectives. Participants were rated by a "STEM affinity score" to quantify their education backgrounds. The design challenge involved exploring a parametric model that represents possible building configurations for a site in Austin, Texas (Fig. 1). Ten dynamic variables generated different geometric and facade configurations (Fig 2.). A post-survey then assessed a participant's focus during the design process.*

Figure 1: Austin Design Challenge Location

Figure 2: Editable Parameters and Design Space



DATA AND RESULTS

For design priorities, SF participants ranked energy, then daylight, then structural weight as their top priorities. For NSF participants, cost, appearance, and daylight were the main priorities (Fig. 3). However, the final performance "scores" achieved by designers do not show strongly correlate to prioritized categories. An overall design value score was calculated based on having low weight and energy with a high daylight potential score. NSF participants had a slightly lower average score overall, which indicates they better addressed the design objectives (Fig. 4).

Figure 3: Average Design Criteria Ranking

1 is top priority, 5 is lowest

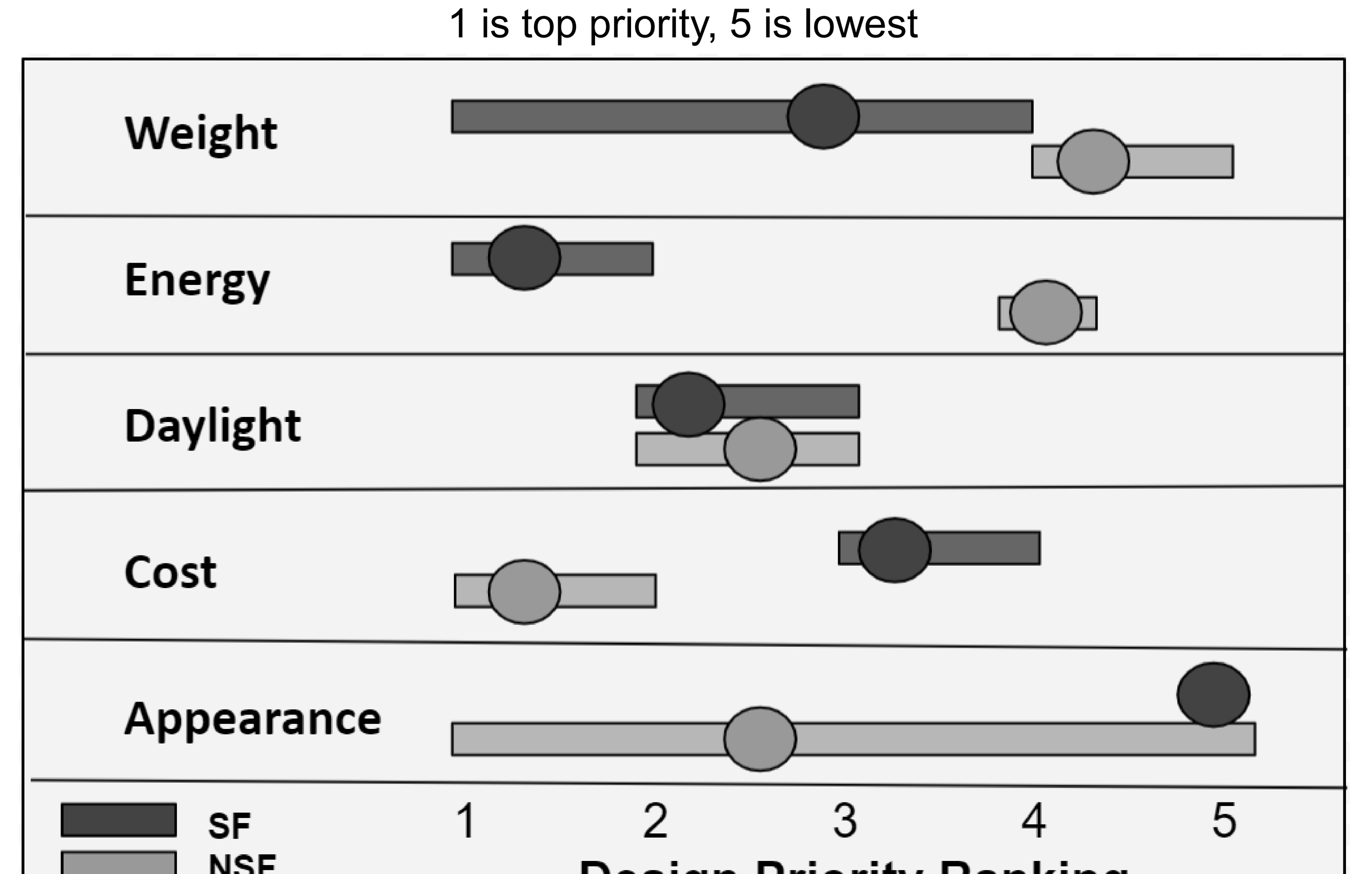
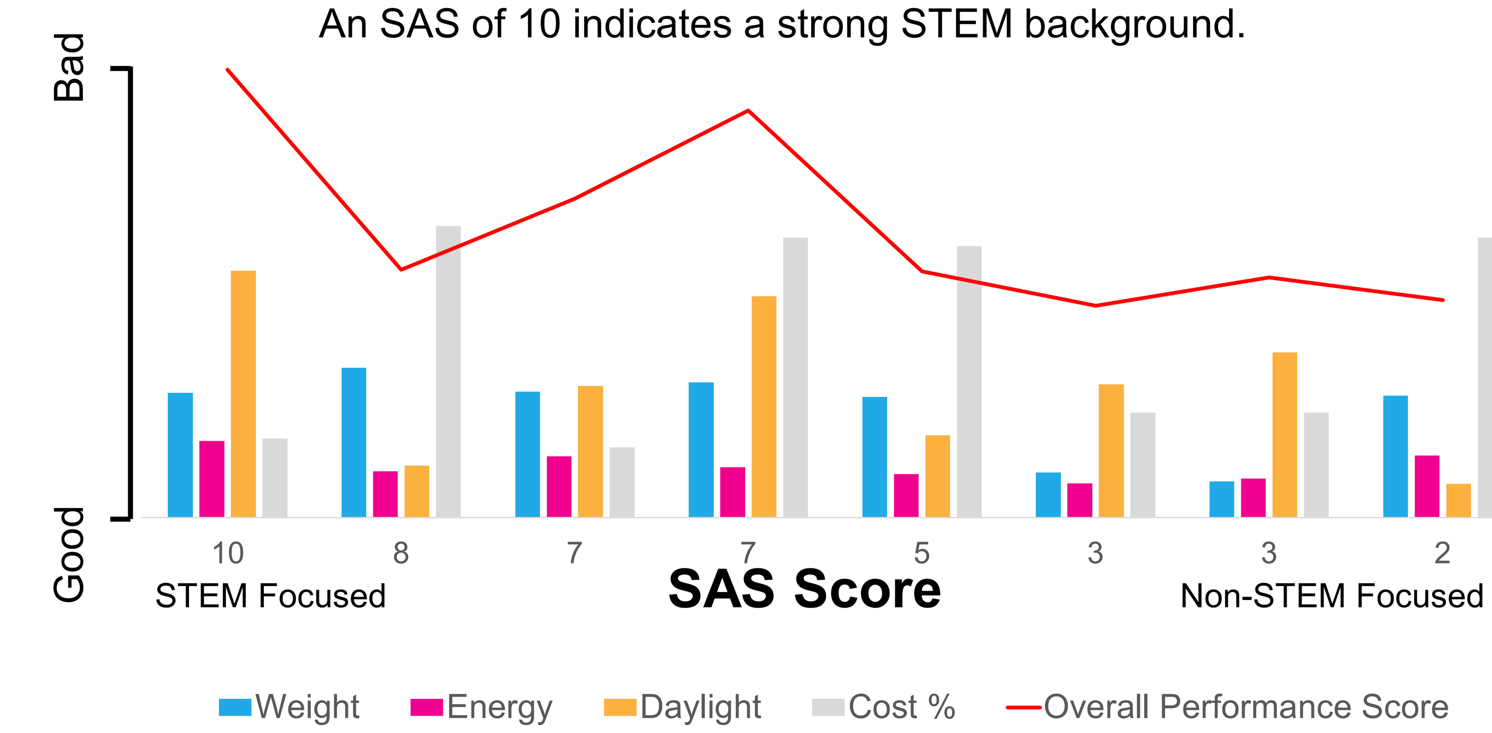


Figure 4: Final Participant Design Scores

Lower values indicate "good" design performance.
An SAS of 10 indicates a strong STEM background.

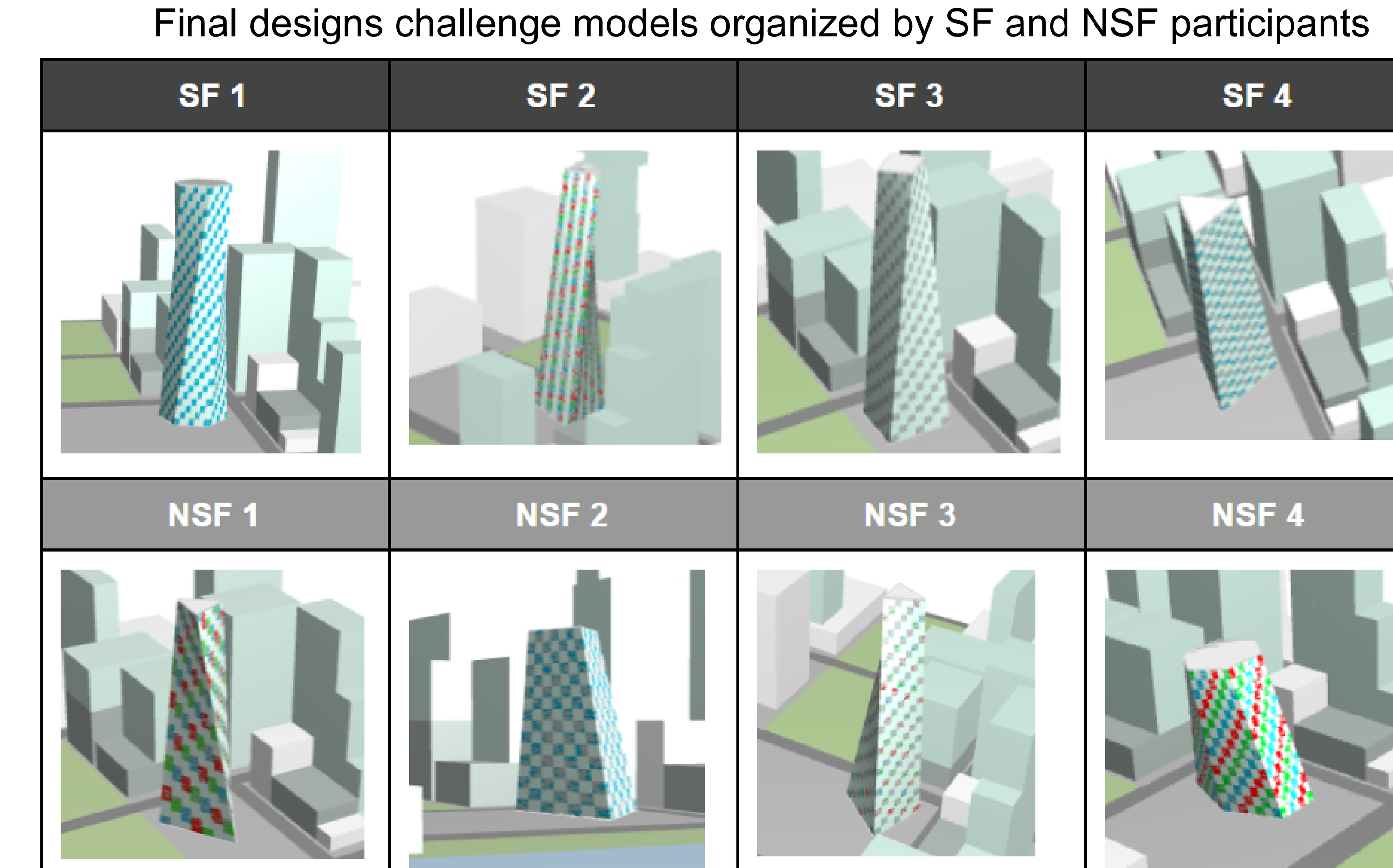


CONCLUSIONS

- *SF designers prioritized energy, daylight, and structural weight over cost and appearance compared to NSF.*
- *Despite their stated design focus, NSF participates scored better on overall design outcomes.*
- *Future data collection is needed to explore relationships between STEM orientation and design priorities + approaches*

Figure 5: The Final Design

Final designs challenge models organized by SF and NSF participants



FUTURE WORK

This was a pilot study on graduate students to test data collection protocols. It laid the foundation for future research on how high school students are influenced by their learning styles and background in STEM.

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