Investigating Intrinsic Motivation as a Benefactor in STEM Education

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Background:

Motivation in the context of STEM education has been widely researched, and studies have consistently shown positive correlations between motivation, student participation, and persistence through obstacles (Bayanova, et al., 2023). While many studies examine motivation broadly (Joy, et al., 2025), fewer studies explore the two types of motivation, extrinsic and intrinsic, individually. **Extrinsic motivations are typically easy for students to identify, while intrinsic motivations often require self-reflection**. With that, there are fewer studies investigating how students can develop their own intrinsic motivators, as they come from internal meaning and personal value in comparison to environmental influences. This study aims to fill the disparity in research regarding **how timely reflections on intrinsic motivators can positively influence STEM students.** It is hoped that weekly reminders of their intrinsic motivations and a greater ability to identify them will result in a stable or increased level of student **autonomy, competence, value, and overall interest** (Joy, et al., 2025).

Methodology:

Data Collection: Facilitators gave PAL students from BIO25, MATH 30, or CHEM 6A a **primer on intrinsic vs. extrinsic motivation** at the start of the study. Surveys administered during the first half of each week within our 12-week study, prompted students to reflect on their motivation to provide qualitative data. Checks administered at the second half of the week contained 1-5 scale questions to provide a quantitative measure of intrinsic motivation based on metrics (autonomy, competence, value, and interest). The total duration of this study spanned Weeks 5-12 of the semester, which each PAL session having either a check or a survey.

Qualitative Question Examples:

- Motivators: "In 1-2 sentences, **what non-materialistic thing motivated you to pursue higher education** (e.g., career passion, parent sacrifice, etc.)?"
- Challenges: "In 1-2 sentences, **what internal challenges have you faced during your pursuit of higher education and how have you learned from overcoming them?**"
- Overcoming Challenges: "In 1-2 sentences, **what personal strength or mindset helps you push through challenges when college feels overwhelming** (e.g., determination, faith, problem-solving, optimism, etc.)?"

Quantitative Questions: "On a scale of 1-5, how much do you agree with the following statements?"

- **Autonomy:** "I feel it is my choice to put effort towards my schoolwork."
- **Competence:** "I feel capable of completing my academic work."
- **Value:** "I feel the work I do is valuable for my personal goals."
- **Interest:** "I find myself interested in what I am learning."

Spotlight Study: To encourage students to reflect on their motivations, "Scientist Spotlight" brief presentations were presented three times throughout the semester on scientists who had overcome barriers (Florence Nightingale, James McCune Smith, and Eloisa Diaz Insunza). Students were asked three times, "On a scale from 1-5, how motivated do you feel by the spotlight presentation?"

Results:

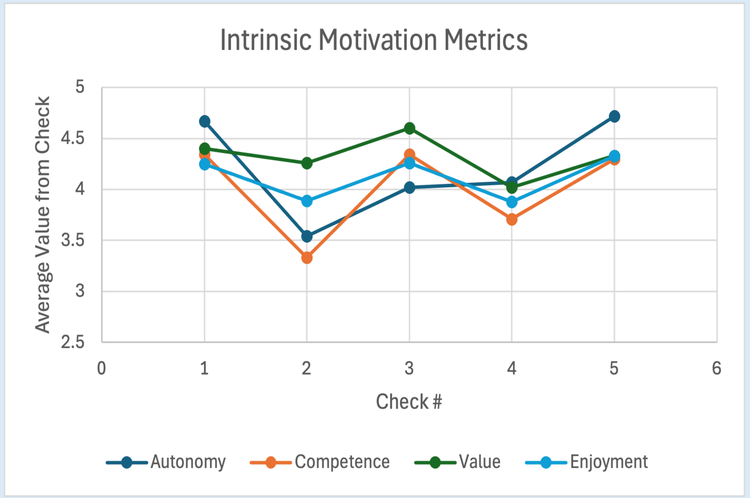

Figure 1: Quantitative data analysis

Conclusions:

The quantitative results were shown to be variable across all four of the intrinsic motivation index categories. Though trends are inconsistent, on average students mostly agree with the statements meant to measure their autonomy, competence, value, and interest regarding their STEM course.

Spotlight study data was steady, showing no change over time. Students averaged about a 3.5 throughout the whole study.

The qualitative data, which mainly served to prompt students to think about their motivators for the purpose of collecting the quantitative data, proved very consistent. From sample sizes of larger than 40, common motivators, challenges, and ways in which challenges were overcome remained coherent.

A huge limitation of the study was the time students spent reflecting. Students were given 5 minutes at maximum to reflect on their prompts, and this is reflected in the consistency in the responses. Allowing more time for these prompts would allow for more personalized data to be collected and potentially help to narrow down the most common challenges, motivators, and ways of overcoming challenges.

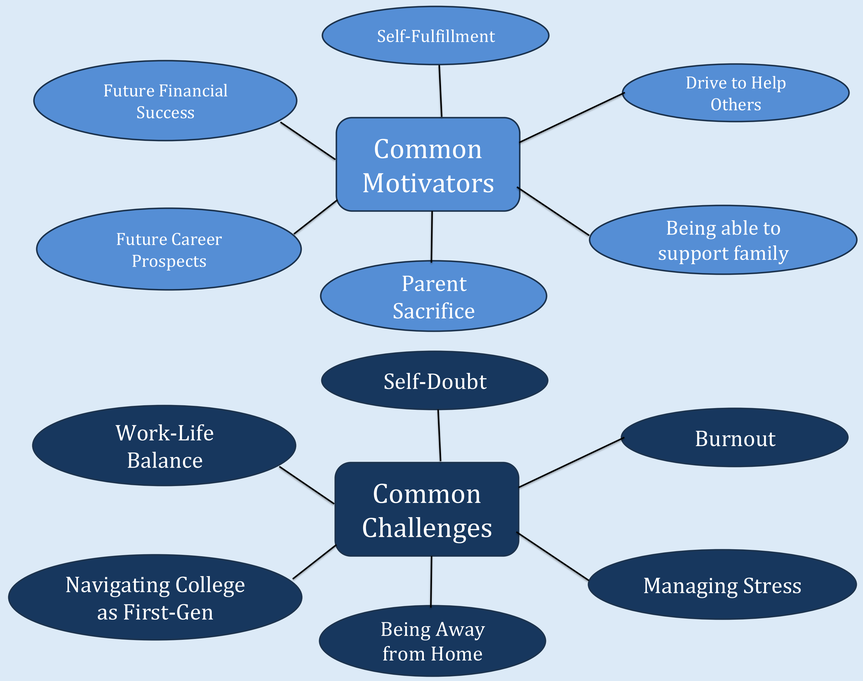

Figure 2: The common motivators, challenges, and the ways by which students overcame challenges are outlined in the diagrams on the right. Each web diagram depicts the most common responses given by students.

Acknowledgements:

We would like to thank Dr. Shanbrom, Dr. Krauel, Dr. Lundmark, and Dr. Pigno for facilitating the development of this project. We would also like to acknowledge the donors to the PAL programs for their contributions. Thank you to the many students who participated in this study.

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