Collaborative Learning in STEM Positively Impacts Student Outcomes

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Introduction

Collaborative learning is an interactive pedagogy shown to improve learning and reduce failure rates among undergraduates in STEM courses. The structure of this approach can vary greatly, as courses can devote any amount of class time to collaborative learning. Collaboration with classmates can influence a student’s perception of their learning environment with implications for their pursuit of a discipline. Over 850 undergraduate students across STEM classes at Duke were surveyed to investigate the intersection of structure, course-related attitudes, and identity. Preliminary data suggest that students in courses with more collaborative learning perceived higher motivation, interest in STEM, and sense of belonging. This has implications for improving student retention rates and leads to further discussions on innovative techniques for more inclusive classroom environments.

Methods

- **Sample size**: 51 courses, 889 Duke students
- **Measures**: student perceptions of course structure, course-related attitudes, and learning outcomes
- **Analysis**: ANOVA with Tukey post-hoc tests

Structure is defined as the percentage of time students spend talking in class (Table 1). White and Asian students are classified as well-represented in STEM fields, and Non-White/Non-Asian students are classified as underrepresented in STEM fields.

Table 1: Course structure attributes (Eddy & Hogan, 2014).

<table>
<thead>
<tr>
<th>Structure</th>
<th>Percent of time spent talking in class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>&lt;15% of course time</td>
</tr>
<tr>
<td>Moderate</td>
<td>15-40% of course time</td>
</tr>
<tr>
<td>High</td>
<td>&gt;40% of course time</td>
</tr>
</tbody>
</table>

Effects of High Structure on Outcomes

Students in classes with high structure reported the following:

- Higher levels of engagement
- Learning more factual knowledge
- More confidence in content knowledge
- Greater ability to apply, analyze, & synthesize knowledge
- More belonging & greater sense of community
- Lower sense of instructor support
- Increased levels of stress

Self-efficacy also became higher for both under-represented and well-represented students (Table 3).

Discussion

Our study investigated the impact of collaborative learning on students’ perceptions of their classroom experiences. Pressures among students taking STEM classes cultivate a palpable level of anxiety. This can reduce enthusiasm and engagement, negatively impacting retention rates. Adopting collaborative learning can alleviate these stressors and foster a more positive classroom environment. Collaborative learning has the potential to reduce achievement gaps and increase self-efficacy for underrepresented students in STEM.

Motivation, a greater sense of belonging and higher confidence in learning course content can affect retention, and thus, pursuit of a career in STEM.

Future Research

- Investigate impacts of collaborative learning among engineering students.
- Compare objective learning outcomes to perceived learning outcomes.
- Examine the impact of collaborative learning among underrepresented students in STEM courses.

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