

Evolution of STEM Leadership Self Efficacy within an NSF S-STEM Program

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An engineering leadership development program (LDP) at a major midwestern university has achieved higher and faster time to graduation rate for engineering transfer students. A peer-comparison study was conducted using support received through the NSF S-STEM program and data gathered during the past 10 years (DeRuntz, et. al 2019) (DeRuntz, et. al 2017) (Palmer, et. al. 2016) (Kowalchuk, et. al 2013). Through the award of a Track 2 S-STEM four years ago, the LDP has now expanded to include other STEM majors at the university. The program investigators have made an important discovery regarding the evolution of Leadership Knowledge among some of the STEM leaders.

The participants in the LDP program showed statistically significant changes on the Leadership Self-efficacy Survey (Bobbio & Manganelli, 2009) and the Motivation to Lead Survey (Chan & Drasgow, 2001) when compared to their peers. However, when comparing student responses over time (pre, post, and post2) in conjunction with student reflections during the focus groups, there may be effects of response-shift bias (Rohs 1999). Qualitative evidence from students' responses to open-ended questions and focus groups suggests significant student growth not appearing in the quantitative analysis. It is possible that participants rated themselves high on the pre-test and then rated themselves lower on the post-test even though they have made tremendous gains.

The most common cause of this response-shift bias is a lack of participant knowledge when taking the pre-survey. The participants "don't know what they don't know" and so they initially rate themselves high. After learning more about leadership and developing skills, they understand better what they "don't know" and therefore rate themselves lower. In other words, participants rated themselves higher on the pre-test and then lower on the post-test; even though they had made significant gains as measured in the other program data collected by the external evaluator. This conclusion is further confirmed by interactions and observations recorded by the program Co-PIs, coordinator, coaches, and senior leadership. Going forward, a retrospective pre-survey will be administered along with the post-survey. This is a standard method for accounting for response-shift bias.

Comparisons

Overall, LDP scholarship students demonstrated significantly higher Leadership Self-efficacy in comparison to their own pre-survey scores ($p = 0.020$) and, in comparison to control group findings ($p = 0.005$). The LDP scholarship students also demonstrated significant growth on the

Motivation to Lead Survey in comparison to their own pre-survey scores ($p = 0.012$) and, in comparison to the control group ($p < 0.001$).

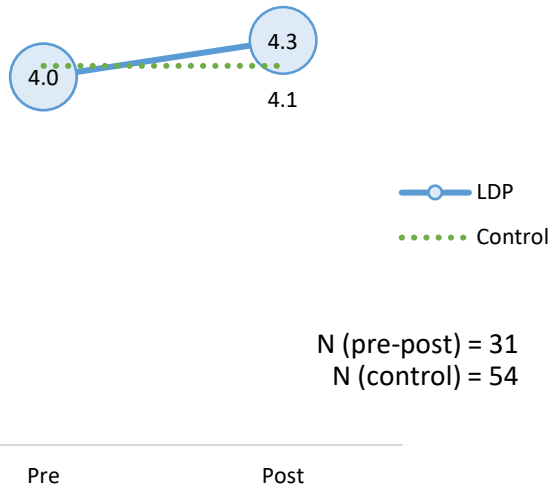


Figure 1: Leadership Self-Efficacy (LSE). LDP students' POST program LSE results showed increased self-efficacy compared to both PRE program and Control Group.

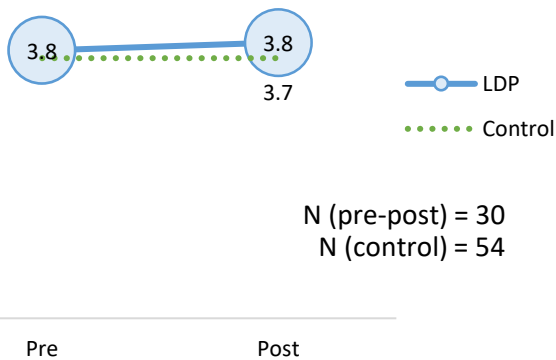


Figure 2: Motivation to Lead (MTL). LDP students' POST program MTL results showed a small increase in motivation compared to both PRE program and Control Group.

Students in some of the survey responses self-reported that they now understand better what they thought they understood before entering the program. Although it seems they regressed in their Leadership Knowledge, this new information is actually a significant indication these leaders have accomplished the first step in leadership development. By their responses they have shown an accurate self-awareness, honesty, and self-discipline. They have demonstrated that they can lead themselves.

Growth

Students' growth of their leadership was examined through instruments that measured their Leadership Self-Efficacy (LSE) and Motivation to Lead (MTL). LDP students showed the most improvement in efficacy after one year of the program. Similarly, LDP students' motivation appears to remain consistent throughout the program.

Combining this with results from the control group, suggest that LDP students come into the program with higher motivation than their peers but develop higher efficacy because of the program. Future surveys will incorporate a retrospective pre-survey to help determine the full impact of the program.

Results from a GRIT8 survey of participants were not statistically significant. However, a small decrease in overall grit value further indicates that student leaders likely changed their opinions and initial views on leadership knowledge. The LDP students' GRIT8 scores were slightly higher than their peers in the control group.

Results

The 2019 – 2020 cohort of LDP scholarship students showed improved Leadership Self-efficacy (LSE) when their post-test scores were compared with their pre-test scores. They also demonstrated higher LSE when compared with a control group. The 2019 – 2020 cohort showed similar results and the same trends on the Motivation to Lead (MTL). Students in the LDP showed improved MTL when their post-test scores were compared with their pre-test scores. They also demonstrated higher MTL when compared with a control group.

Similar levels of growth are evident when looking at LDP students overall for all the years of the program. It is interesting that the growth on the LSE is not as drastic while the growth on the MTL is more pronounced.

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