



Change in Peer Efficacy: An investigation of student perceptions

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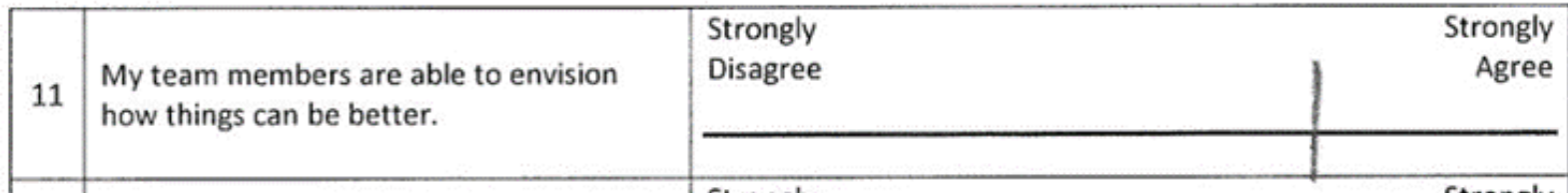
- Engineering Design taught in a project based class (ME 4010)
 - Lecture phase
 - Engineering design process
 - Design tools
 - Project management
 - Second phase
 - Forming design teams
 - Semester project
 - Design reviews
- Emphasis on team based projects
- Research on engineering design teams
 - Leadership
 - Team composition and diversity
 - Functional behaviors
 - Communication
- Research gap: student perception of team members

- How do student teams initially perceive their team members?
 - Perception of engineering skills?
 - Perception of communication?
 - Perception of social impact?

- Does students perception of their team members change over the course of a design project?
 - Which aspects of their perception change?

- Survey to ME 4010 Students
 - Early semester (before meeting client)
 - End of semester (near project end)
- Survey categories
 - Empathy (2)
 - Knowledge (2)
 - Innovative (12)
 - Creative (2)
 - Project Skills (4)
 - Tactile/Visual skills (5)
 - Communication (4)
 - Social Impact (8)
- 29 out of 39 survey items are external
 - From a study on change in self-efficacy (Zapas-Ramos & Perez-Vargas)
 - Adapted to peer efficacy

- Participants
 - 128 ME 4010 Students
 - Mostly 21-22 year old
 - At least 90 credit hours (~45 engineering)
 - 21 design teams
 - Between 6-7 students each
- Data Collected
 - Survey responses at project start and project end
 - Responses on a 100mm line



- Roughly 9000+ responses collected
- Matlab based image processing used for analysis

- Overall mean of 70% (from 51% to 78%)
 - Better perception on innovative, creative and project skills
 - Worse perception on communication and social impact
- Overall standard deviation of 17% (from 12% to 22%)
 - Lower variance on innovative, creative and project skills
 - Higher variance in communication and social impact

Q#	Initial Mean	Q#	Initial Mean	Q#	Initial Mean
1	75%	14	74%	27	72%
2	75%	15	68%	28	66%
3	67%	16	73%	29	72%
4	75%	17	67%	30	51%
5	68%	18	72%	31	61%
6	75%	19	78%	32	66%
7	63%	20	75%	33	74%
8	76%	21	75%	34	71%
9	75%	22	70%	35	67%
10	76%	23	71%	36	69%
11	76%	24	74%	37	66%
12	71%	25	66%	38	67%
13	74%	26	72%	39	65%

- Overall mean of 70%
 - Lowest at 57%, highest at 75%
- Non-negative mean change in 16 out of 39 items
- Largest change in mean of 6%

Q#	Final Mean	Delta	Q#	Final Mean	Delta	Q#	Final Mean	Delta
1	71.8%	-2.9%	14	73.5%	-0.2%	27	73.1%	0.9%
2	71.7%	-2.8%	15	67.2%	-0.3%	28	72.4%	6.0%
3	69.6%	2.9%	16	70.8%	-2.0%	29	73.1%	0.6%
4	70.8%	-4.4%	17	67.1%	0.4%	30	57.1%	5.8%
5	67.7%	-0.5%	18	71.0%	-0.5%	31	63.9%	3.4%
6	74.8%	-0.6%	19	74.3%	-3.6%	32	68.6%	2.4%
7	68.7%	5.5%	20	74.0%	-0.6%	33	71.7%	-2.7%
8	71.9%	-4.1%	21	73.7%	-0.9%	34	64.9%	-6.0%
9	73.0%	-1.9%	22	71.1%	0.6%	35	65.4%	-1.2%
10	73.4%	-2.7%	23	69.8%	-0.8%	36	68.6%	-0.1%
11	72.4%	-3.2%	24	72.0%	-1.9%	37	66.5%	0.4%
12	71.3%	0.4%	25	67.4%	1.3%	38	68.3%	1.1%
13	69.8%	-3.8%	26	72.4%	0.5%	39	68.1%	3.6%

Results (t-Tests)

- Two-sample t-Tests between early and late semester responses
 - Alpha of 0.05, two-tailed, unequal variances
- 9 out of 39 items showed significant changes
- #34 is about improving k-12 education (significant decrease)

Q#	p-value	Q#	p-value	Q#	p-value
1	0.079	14	0.926	27	0.611
2	0.075	15	0.864	28	0.008
3	0.152	16	0.302	29	0.745
4	0.003	17	0.874	30	0.034
5	0.805	18	0.785	31	0.150
6	0.742	19	0.040	32	0.264
7	0.010	20	0.709	33	0.120
8	0.029	21	0.593	34	0.011
9	0.269	22	0.710	35	0.594
10	0.109	23	0.643	36	0.980
11	0.041	24	0.291	37	0.858
12	0.796	25	0.525	38	0.614
13	0.049	26	0.799	39	0.123

Results (Team Based Categorical)

- More than half of the teams
 - Positive change in the knowledge, innovative, creative, tactile/visual, and communication
 - Negative change in empathy, project skills, and social impact

Team	Empathy	Know- ledge	Innovative	Creative	Project Skills	Tactile/ Visual	Comm.	Social Impact
1	1.0%	4.9%	-1.3%	-6.4%	2.5%	-0.7%	4.8%	-10.0%
2	-20.6%	-18.3%	-7.0%	-4.3%	-7.4%	1.3%	-1.3%	0.1%
3	-1.2%	-3.3%	2.6%	2.2%	3.2%	0.2%	0.4%	0.3%
4	-13.5%	-0.4%	-4.7%	-8.8%	-6.8%	-5.8%	-8.5%	-3.5%
5	-4.3%	1.1%	3.6%	3.8%	1.4%	2.5%	5.5%	3.7%
6	0.5%	2.1%	1.2%	6.0%	-2.9%	-1.4%	0.8%	-1.6%
7	-6.1%	-2.2%	0.0%	0.7%	-1.8%	1.8%	-4.9%	-0.2%
8	-4.8%	1.7%	-3.7%	-5.8%	-3.8%	2.2%	1.5%	-6.1%
9	3.4%	1.0%	-0.8%	1.0%	-2.8%	-2.5%	-6.2%	-0.5%
10	-0.7%	0.1%	-6.1%	3.1%	-13.3%	1.2%	-6.2%	-10.5%
11	-18.9%	-15.0%	-9.7%	-9.1%	-14.1%	-12.8%	-6.3%	-15.7%
12	7.5%	19.8%	10.0%	5.5%	5.7%	2.2%	1.1%	3.8%
13	-3.0%	-6.2%	0.9%	0.1%	-0.6%	4.8%	2.5%	6.2%
14	5.1%	2.6%	4.4%	1.8%	2.1%	4.1%	7.4%	-3.9%
15	0.9%	4.2%	1.8%	1.9%	-3.1%	5.7%	-1.0%	4.6%
16	6.8%	4.9%	7.6%	2.6%	3.5%	4.2%	7.9%	6.6%
17	-10.3%	-8.4%	-7.1%	-6.3%	-8.6%	-7.3%	-9.9%	-8.1%
18	-3.1%	6.5%	2.0%	2.2%	-3.9%	9.4%	13.0%	7.5%
19	-0.2%	2.9%	7.0%	7.3%	3.0%	7.9%	10.8%	13.9%
20	-15.8%	-6.3%	-15.1%	-18.1%	-13.8%	-7.0%	-14.4%	-8.9%

- Students' initial perceptions
 - Positive innovative, creative, and project skills
 - Negative communication and social impact
- Peer efficacy increased regarding...
 - Engineering knowledge
 - Communication abilities
 - Product development skills
- Peer efficacy decreased regarding...
 - Social impact
 - Customer empathy
 - Project skills

- How are student perceptions related to their course performance?
 - Final grades in the course
 - Grades specific to group projects
- How do student perceptions change in ME 4020?
 - Are initial perception in ME 4020 different from those in ME 4010?
 - Are the changes greater/smaller or remain the same?
- How are ME 4010 students impacting elementary school students?
 - Improved perception of engineering?
 - Specific aspects of student perception?

QUESTIONS?

#	Category	Statement
1	Empathy	My team members understand the needs of people by listening to their stories.
2	Knowledge	My team members find connections between different fields of knowledge.
3	Knowledge	My team members seek out information from other disciplines to inform my own.
4	Innovative	My team members are able to identify opportunities for new products and/or processes.
5	Innovative	My team members question practices that others think are satisfactory.
6	Creative	My team members are able to come up with imaginative solutions.
7	Innovative	My team members are able to make risky choices to explore a new idea.
8	Empathy	My team members consider the viewpoints of others/stakeholders.
9	Project Skills	My team members are able to evaluate the success of a new idea.
10	Project Skills	My team members are able to apply lessons from similar situations to a current problem of interest.
11	Innovative	My team members are able to envision how things can be better.
12	Innovative	My team members are able to do things in an original way.
13	Project Skills	My team members are able to set clear goals for a project.
14	Tactile/Visual	My team members are able to troubleshoot problems.
15	Innovative	My team members stay informed about new ideas (products, services, processes, etc.) in my field.
16	Communication	My team members are able to communicate ideas clearly to others.
17	Communication	My team members provide compelling stories to share ideas.
18	Tactile/Visual	My team members learn by observing how things in the world work.
19	Innovative	My team members are able to solve most problems if My team members invest the necessary effort.
20	Innovative	My team members are resourceful when handling an unforeseen situation.

#	Category	Statement
21	Innovative	My team members are able to suggest new ways to achieve goals or objectives.
22	Innovative	My team members test new ideas and approaches to a problem.
23	Communication	My team members share what they have learned in an engaging and realistic way.
24	Project Skills	My team members are able make a decision based on available evidence and opinions.
25	Innovative	My team members are able to relate seemingly unrelated ideas to each other.
26	Creative	My team members think of new and creative ideas.
27	Tactile/Visual	My team members are able to model a new idea or solution.
28	Innovative	My team members find new uses for existing methods or tools.
29	Tactile/Visual	My team members are able to explore and visualize how things work.
30	Communication	My team members enjoy reading about engineering.
31	Tactile/Visual	My team members do engineering related projects outside of class.
32	Social Impact	My team members consider engineering to be fun.
33	Social Impact	My team members see engineering as a means to improve quality of life.
34	Social Impact	My team members are interested in improving engineering education for K-12 students.
35	Social Impact	My team members are aware of contemporary issues in engineering.
36	Social Impact	My team members pursue engineering to make a positive impact on the world.
37	Social Impact	My team members pursue engineering to make a positive social impact.
38	Social Impact	My team members pursue engineering to make a positive economic impact.