AN ASSESSMENT OF SELF-CONSTRUAL AND COMPETITION/COOPERATION AMONG MINORITY STUDENTS ENROLLED IN AN ENGINEERING PROGRAM AT NORTHERN NEW MEXICO COLLEGE: AN EXPLORATORY DESCRIPTION OF SOCIAL SCIENCE RESEARCH EXPERIMENTAL METHODS AND PROCEDURES

Jazmine Lopez

Northern New Mexico College
Department of BAIS, Psychology

Abstract

Do aspects of culture, unique to a specific student population, impact student achievement? This study examined self-construal (independent/interdependent) and motivation in terms of whether competition or cooperation motivates a cohort of engineering students enrolled at a rural minority-serving small college. The research question was: How does self-construal and perceptions of motivation affect students? A focus group was conducted, which measured competitiveness and cooperativeness as well as yielding qualitative results. The focus group, as well as survey was done by 14 participants in Fall 2016. The results of this research is presented in the following information.

Introduction

The College of Engineering and Technology at Northern New Mexico college is deeply interested in developing a research-generated knowledge base of how its student demographic learns complex foundational Physical Science concepts (Anderson, Kevin J. B., Sandra Shaw Courter, Tom McGlamery, and Christine G. Nicometo, 2010). These authors suggest that to understand engineering education, it is crucial to also study identity. Therefore, this project seeks to determine: 1) whether introduction to Physics concepts theoretically or through active learning and project-based activities leads to increases in learning, understanding, application of foundational concepts, and greater success in upper division courses; and 2) whether Native American and Hispanic students with high degrees of interdependent self-construal (Kitayama and Singelis), respond better to teamwork rather than competitive exercises. Overall, this project reports preliminary data drawn from research done at Northern New Mexico college developed to look at increasing achievement in a STEM Engineering cohort, by examining under-represented minorities' goals, self-construal's, and motivations such as competitiveness or cooperation. The purpose of this study is to acquire information concerning the attitudes about success and competition and how those feelings affect a student's self-construal. If the results of this study are not as predicted, the null-hypothesis must be accepted.

Theory

Because the student participants in this study attend school in such a culture-driven area, my theory is that the students' connections to their culture will cause them to be more interdependent and enjoy working with others to achieve independent and group success. This theory stems from a study from Kitayama and Singelis who suggest that students with a higher degree of self-construal due to cultural values will respond better to teamwork rather than competitiveness.

Hypothesis

Some possible hypothesis for this research project include:
1. A better attitude about cooperation, results in a better attitude about competition.
2. A better attitude about cooperation, results in a worse attitude about competition.
3. A worse attitude about cooperation, results in a better attitude about competition.
4. A worse attitude about cooperation, results in a worse attitude about competition.
5. There is no correlation between attitudes about cooperation and attitudes about competition (the null).

Data Collection and Methods

Sample Selection N=14

In order to acquire the information needed for this project, a Purposive sample selection was used because only STEM Engineering majors from Northern New Mexico College were needed. Our sample consisted of a class of 14 students who were given extra credit for completing our survey and attending a focus group. The focus group was held on November 9, 2017. The following chart expresses how many of the 14 subjects are scholarship recipients.

Q3 I guess we could have just asked this one! But,again, we are only using this in case you forget to provide your Banner ID, to determine whether you are a scholarship recipient or not, and to provide you with extra credit. Are you a scholarship recipient?

NO 42.86% (6)   YES 57.14% (8)

Data Analysis and Findings

Quantitative Analysis and Results

Introduction:

Most data are initially qualitative; however, my data is both qualitative and quantitative. My quantitative data was collected through a survey with a Likert scale, and qualitative information was collected through multiple focus group interviews. The purpose of this study is exploratory. A simple bivariate analysis will be utilized to check for correlation of my variables. Because the data for my research project contains both qualitative and quantitative data, I will have to use coding to analyze my data. To analyze my quantitative data, I will use SurveyMonkey to create tables and charts to analyze and present my data. Qualitative data, such as focus group responses, must be coded and analyzed for patterns and similar answers. This information will then be interpreted and presented as percentages or described in words. The ethics of analysis must also be considered, especially when it comes to reporting qualitative data that may include names or identification numbers that must be kept confidential. The results of the quantitative analysis are presented below:

Univariate:

The respondents of the survey were asked twenty multiple choice questions. Eight of the questions pertained to students' attitudes toward "cooperation" and twelve questions were asked to determine students' feelings about "competition". The quantitative data in my research was collected through a survey containing a Likert scale containing the options "Never", "Rarely", "Sometimes", "Often", and "Always". The questions asked are provided below in tables 3a and 3b:

Table 3a. Questions about attitudes toward cooperation. (N=14)

	Never	Rarely	Sometimes	Often	Always	Total
.) Individual success can be achieved while working with others	0.00% 0	0.00% 0	35.71% 5	28.57% 4	35.71% 5	14
²) Joint effort is the best way to achieve success	0.00% 0	0.00% 0	21.43% 3	57.14% 8	21.43% 3	14
³) To succeed, one must cooperate with others	0.00% 0	0.00% 0	23.08% 3	38.46% 5	38.46% 5	13
⁴) Success is only achieved through individual effort	0.00% 0	14.29% 2	50.00% 7	28.57% 4	7.14% 1	14
⁵) Success is best achieved through cooperation rather than through competition	0.00% 0	7.69% 1	15.38% 2	53.85% 7	23.08% 3	13
⁶) In the end, cooperation with others is not compatible with success	15.38% 2	69.23% 9	7.69% 1	7.69% 1	0.00% 0	13
⁷) Shared efforts can lead to both individual and group success	0.00% 0	0.00% 0	0.00% 0	42.86% 6	57.14% 8	14
⁸) I enjoy working with others to achieve joint success	0.00% 0	7.14% 1	28.57% 4	35.71% 5	28.57% 4	14

The dependent variable to be analyzed in the table above (3a) is attitudes about "cooperation". As shown in the table, 5 out of 8 questions were answered by all 14 participants, while 3 out of 8 questions were answered by only 13 out of 14 participants. In looking at the dispersions and measures of central tendency, and being mindful that there were only 14 respondents, still the results from this group of Engineering students suggest that the students surveyed indicated individual success was best achieved by working with others was more strongly endorsed (9 of 14, or approximately 64%), as compared to 5 of the 14 responding "sometimes", and no students endorsing 'never or rarely'. Another way to look at the students' ideas about whether success is cooperative versus competitive is to compare the dispersions of answers between question 3) To succeed, one must cooperate, and question 4) Success is only achieved through individual effort. In this comparison, it can be seen that higher endorsement is given to working with others (10 of 14 endorsing either often or always) for the question about working with others as compared to the question about individual effort (where 2 or double the percentages stated "rarely" for individual effort being superior for success to working with others). While the data have a small "N" size, if these trends continued, the results for the dependent variable would suggest that, even in Engineering, a STEM degree, students majoring prefer working with others rather than individual effort. Another clue is that the only question in this scale which had endorsements in the Likert scale of "never" was question 6) In the end, cooperation with others is not compatible with success (15.38% or 2 of 14, and there were no endorsements for "always".

Similar results were found for the questions about attitudes toward competition in Table 3b, below. The independent variable here relies upon a theory that motivation to succeed is one way to explain whether the individual student prefers learning in company with others or by him or herself. Thus, the table below displays answers the respondents gave regarding their attitudes about their motivations to succeed.

Table 3b. Questions about attitudes toward competition. (N=14)

	Never	Rarely	Sometimes	Often	Always	Total
1) It is important to me to do better than others	0.00% 0	7.14% 1	42.86% 6	35.71% 5	14.29% 2	14
2) Success is not very important to me	64.29% 9	14.29% 2	14.29% 2	0.00% 0	7.14% 1	14
3) By achieving success, I also get other things which are important to me	0.00% 0	0.00% 0	14.29% 2	28.57% 4	57.14% 8	14
4) To succeed, one must compete against others	7.14% 1	21.43% 3	42.86% 6	21.43% 3	7.14% 1	14
5) People who succeed are more likely to have satisfying lives	0.00% 0	0.00% 0	28.57% 4	50.00% 7	21.43% 3	14
6) Success is something I am willing to work hard for	0.00% 0	0.00% 0	7.14% 1	35.71% 5	57.14% 8	14
7) I enjoy the challenge of competing against others	0.00% 0	0.00% 0	50.00% 7	28.57% 4	21.43% 3	14
8) The rewards of success outweigh the costs	0.00% 0	0.00% 0	21.43% 3	50.00% 7	28.57% 4	14
9) Success is my major goal in life	0.00% 0	7.14% 1	14.29% 2	50.00% 7	28.57% 4	14
10) I am happier when I am not striving to succeed	30.77% 4	38.46% 5	23.08% 3	7.69% 1	0.00% 0	13
11) I feel better about myself when I am working toward success	0.00% 0	0.00% 0	14.29% 2	50.00% 7	35.71% 5	14
12) I feel that being competitive is necessary to be an Engineering major	7.14% 1	7.14% 1	50.00% 7	21.43% 3	14.29% 2	14

The independent variable to be analyzed in the previous table (3b) are attitudes about "competition". As shown in the table, all 14 participants answered 11 out of 12 questions, and only one question was answered by 13 out of 14 participates. Dispersions and measures of central tendency indicate that, motivations to succeed fall into these areas:
- Success is not very important (Q2)
- Success means rewards (Q3, Q5, Q8)
- Success requires competitiveness (Q4, Q12)
- Success is its own reward (Q9)
- Success is a detriment to happiness (Q 10)
- Success determines self-esteem (Q1, Q11)

In looking at the column of answers "Never", the only question that was strongly endorsed was Q2, "Success is not very important to me" at a level of 9 out of 14 stating that was never true for them (64.29%). This was the strongest finding to emerge from this data. The results for the other motivations seem much more mixed. For example, many endorsements specifically asking about competitiveness fell into the middle range (Sometimes) of the Likert scale as follows, thus supporting the dependent variable findings above.

Qualitative Analysis and Results

MEASURING FEELINGS TOWARD SUCCESS AND COMPETITION

The following table contains information that was obtained in a focus-group setting of Engineering students on November 9, 2017. The students were asked to complete a short survey, using a Likert scale, then provide verbal answers in a focus group conversation. The table below includes direct quotations from the focus group and is coded to easily identify themes. Respondents were given numbers to protect their identities. The information provided below the tables is the content analysis portion of my research.

Table 2a: Coding/Analysis of Focus Group Qualitative Information (N=14)

	Question 5: Comments on learning style	Question 7: Comments on Competition	Question 8: Why did you pick Engineering as a major?	Question9: Thought about Changing the major?	Question10: Do you learn more by reading theoretically or by hands on in the lab?	Question11: Do you prefer working in groups or individually?
Respondent #1	"Do I work better with or without others?"	"Are you able to hang with some advanced thinkers of your peers?"	"The structure of everyday objects making life simpler intrigues me."	"No, my teachers are great, nothing made me want to change."	"Hands on, but with reference data."	"Individual work is great for me but group work is nice for certain projects."
#2	"Amazing questions and beautiful options."	"I love competition."	"To challenge myself and achieve my dreams."	"If I were to change it would be environmental science."	"Reading and calculating."	"Mostly individually but when I don't understand something I reach out."
#3	"Your attitude greatly impacts your learning."	"You need a competitive attitude that can be individual or linked to a group to succeed."	"For a challenge and design."	"No"	"Doing hands on labs."	"In groups."
#4	"Local group vs networking"	"Point of view of success."	"(math major) Love math and physics, came naturally over time."	"No! Love of the field."	"Reading and calculating, most of my interest is in theoretical physics. But need to visualize in your own way."	"Typically, I learn individually, but groups can offer different perspective."
#5	"Leadership, listening, and cooperating with others has a greater potential for success."	"Healthy competition is good for the individuals involved and for the great community."	"I've always had a nack for computers and electronics since I was a kid. Taking them apart and trying to figure out how they work."	"Yes, I have to business cause business is much easier and I'm very good at business, but technology is and always been my passion. I considered changing due to the difficulty."	"I learn more by hands on because in general I'm a tactile learner and it sticks more in my mind if I can visually see and feel it versus reading and calculating the theoretical aspects of physics."	"I, myself, prefer individually so I can handle better time management with myself versus having to work on trying to make my schedule work with others."
#6	"Cooperating with others largely depends on the other person(s) intellectual ability, attitude towards the project."	"So far I did not have the need to compete in order to be an engineering major."	"I like technical challenges, solving programs."	"I never thought about changing my major, Sticking to plan."	"Hands on. Always."	"I prefer learning individually."
#7	"Group and individual projects."	"Competition."	"Science and math interests me!"	"No"	"By both."	"Individually."
#8	"Being a "team player" is great; although not necessary always."	"Competition is a great motivator, but not the only one."	"Because computers are more interesting than people. Specifically, for IET."	"My prior major was psychology. I like information more than psychology."	"Both! All aspects; reading, calculating are critical. Balance and integration (creative) are beneficial."	"Both, depending on the type of work."
#9	"In general, I don't like to work in groups."	"Success and competition are necessarily linked."	"I find the field interesting."	"If I changed it would be to physics but I like engineering more."	"Reading and calculating."	"In group work 1 person usually does most of the work. I dislike working in groups. I think it depends on the intelligence of my group members if I like working with them or not."

Table 2b: Qualitative Content Analysis of Table 2a

	Question 5: Comments on learning style	Question 7: Comments on Competition	Question 8: Why did you pick Engineering as a major?	Question9: Thought about Changing the major?	Question10: Do you learn more by reading theoretically or by hands on in the lab?	Question11: Do you prefer working in groups or individually?
Common Words/ Themes	*Attitude *Cooperation *Learning to work alone *Everyone needs help sometimes	*Competition *Success *Not much need to compete	*Challenge *Computers *Understand how things work	*7/14 "no" *4/14 "yes" *3/14 did not give a yes or no	*6/14 "hands-on" *3/14 "reading and calculating" *5/14 prefer both	*7/14 "individually" *4/4 "groups" *3/4 "both"

Some of the questions asked were aimed at finding out why these students chose Engineering as their major, if they've ever considered changing majors, and why, and if they learn better using a hands-on approach or by reading and calculating information. Our results from the latter question were that 6/14 students preferred hands-on, 3/14 preferred reading and calculating, and 5/14 learn best using a combination of the two. Another question we were interested in was whether students preferred to work individually or in groups. Our results of this question were a bit surprising when compared to the information stated above. Out of 14 students asked, 7 students stated they prefer to work individually, 4 students preferred group work, and 3 students were comfortable in both situations. Students were also asked whether or not they believe culture has an effect on whether they work best individually or in groups and the outcome was that 2/14 believed culture is influential, 3/14 believed culture was not influential, 3/14 were not sure about this topic, and 6/14 preferred not to answer this question.

To further analyze this data, I have implemented a few methods to sort and evaluate the qualitative data received. To evaluate questions 10 and 11, I looked to Gardner's Multiple Intelligences to sort the answers given to the questions.

Q10: "Do you learn more by reading theoretically or by hands on in the lab?"
- Logical-Mathematical: enjoys reasoning and calculation- 3/14 people prefer.
- Bodily-Kinesthetic: enjoy hands on learning and making things- 6/14 people prefer.
- 5/14 people prefer both.

Q11: "Do you prefer working in groups or individually?"
- Interpersonal: enjoys understanding and interacting with others (groups)- 4/14 people prefer.
- Intrapersonal: enjoy understanding their self, independent (individually)- 7/14 people prefer.
- 3/14 people prefer both.

To analyze question 7 which was about "Comments on Competition", I decided this question is best analyzed on a continuum that ranges from comments that indicate how much the participants "like" competition. This continuum ranges from a "little bit" to "a great deal". On the lower side of the continuum are comments such as "No sense of being competitive, we are all working towards the same goal or degree". And on the higher side of the continuum are comments such as "I love competition".

A final form of analysis used is a comparison and contrast of the answers subjects gave for questions 5 and 11. This would be a comparison of the questions "Comments on learning style" and "Do you prefer working in groups or individually?". The answers to these two questions predict learning styles and how independent the Engineering students that were surveyed are.

Discussion

Implications

More research needs to be done. For one, a bigger sample should be collected for each of these students over time to see if their attitudes change. For another, a comparison group of non-STEM non-Engineering majors would improve the rigor and stability of the results. An implication of these findings for the engineering instructors is that a combination of team assignments and individual work may be best fitted to teach and provide success for these students, as more suited to their attitudes and motivations regarding competition and success. One suggestion would be to implement team assignments, and individual assignments, and then to measure the academic success for each with testing outcomes.

Ethical Considerations

The main ethical concern that should be avoided in my project is keeping subjects' identities hidden, especially since the subjects were asked to provide their names and school ID's on their survey. In order to keep subjects' name's confidential, all qualitative answers were given numbers.

Data Limitations and Directions for Future Research

For future research, a stronger focus on race/ethnicity and how students feel toward their cultural communities would be relevant to comparing how they feel about success and competition. In the future, I hope to gather this information and see how feelings toward cultural communities and feelings toward success and competition correlate.

Conclusions

Though the data from the qualitative survey suggests that students in the sample believe success can be achieved through cooperation rather than competition (Question 5: "Success is best achieved through cooperation rather than through competition" was answered with the majority of the answers being the answer choice "often" at 53.85%) and (Question 2: "Joint effort is the best way to achieve success" was answered with the majority of the answers being the answer choice "often" at 57.14%), the qualitative information gathered suggests that more students prefer to work alone as opposed to in groups (Q11: "Do you prefer working in groups or individually?"
- Interpersonal: enjoys understanding and interacting with others (groups)- 4/14 people prefer.
- Intrapersonal: enjoy understanding their self, independent (individually)- 7/14 people prefer.
- 3/14 people prefer both.)

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Acknowledgements

For more Information contact: Jazmine Lopez

Jazmine_s_lopez@nnmc.edu