Table of Contents

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Strengths and Success: Technology and Engineering Student Perceptions

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ABSTRACT

Strengths have been hypothesized to play a role in how a person approaches leadership and problem-solving. The Clifton StrengthsFinder (CSF) is a common way to identify and measure an individual's strengths. This research examined the role of CSF strengths in the academic success of engineering and technology students within a large, midwestern, research-intensive, land-grant university. The purpose of this research was to identify how students use their CSF strengths and to identify if students perceive a connection between strengths and their success. This research utilized semi-structured interviews with students to gather detailed qualitative information on student perceptions of success and CSF strengths. The survey collected information on student perceptions of how useful strengths are in various scenarios and if there is a connection between student success and CSF strengths. Students perceived that there were a set of strengths that make some students more successful than others, but they were not able to identify what those strengths were. Primarily, students perceived CSF strengths were useful in group academic tasks but were not useful in individual academic tasks. Based on the responses from these interviews, students are not aware of all the scenarios in which they can use their strengths.

Keywords: Clifton StrenghtsFinder, Student Success, Student Perceptions of Success

INTRODUCTION

Strengths have been hypothesized to play a role in how a person approaches leadership and problem-solving. The Clifton StrengthsFinder (CSF) is a common way to identify and measure an individual's strengths. Understanding one's strengths has been shown to increase workplace and academic success around the world (Asplund, Agrawal, Hodges, Harter, & Lopez, 2014; Cantwell 2006; Tomkovick & Swanson 2014). Yet, little research has examined how people use their strengths to increase their success. This research explored the role of strengths in the classroom success of students in an engineering department at a large four-year, public, research-intensive land-grant university. The department included students in two fields of study: technology and engineering. Since 2015, departmental students have been taught how to utilize the information from the Clifton StrengthsFinder because it was hypothesized to help them better use their talents and natural aptitudes to be successful academically (Louis, 2012). However, this hypothesis has not been tested with the students in the department.

The disciplines of Science, Technology, Engineering, and Mathematics (STEM) are competitive and require high academic performance from students. One result of the rigor is the exit of some students from STEM fields before graduation (Geisinger & Raman, 2013; Kaleita et al., 2016; Rask, 2010), yet the reasons students leave are not always academic (Maltese & Cooper, 2017). Other research has explored academic factors predicting student success in technology (Mosher, 2018) and engineering programs (Kaleita et al., 2016). Published research has suggested that success predictors may differ between students in engineering degree programs as compared to those in technology degree programs. Specifically, common academic predictors such as ACT test scores, important in determining engineering student success, were not found to be significant predictors of GPA for technology students (Mosher, 2018).

This difference was an interesting finding, given that departmental majors in technology and engineering majors both focus on STEM-based problem solving. Entrance data trends suggest that differences in academic indicators such as high school class rank, high school GPA, ACT scores, and math placement test scores were small between technology and engineering students (Mosher, 2018). One hypothesis is that some of the differences in academic performance among students in engineering and technology fields could be related to differences in student strengths.

Further evidence to support this hypothesis comes from the characterization of the engineering and technology students in an engineering and technology department at a midwestern, research-intensive, land-grant institution. Ryan, Mosher, and Freeman (2020) and Ryan and Mosher (2020) examined differences in CSF strengths and leadership domains between engineering and technology students. The result of this research identified that although students in engineering

and technology majors have similar CSF strengths and leadership domain profiles, there is not one prevalent pattern for all engineering and technology students. The differences in strengths among different groups of students suggest that there could be a connection between strengths and academic performance.

The Clifton StrengthsFinder

The Clifton StrengthsFinder is a tool used to measure how people think, feel, and behave in various scenarios and provide guidance on how to better employ one's natural talents to continuously improve (Asplund et al., 2014). Strengths drive the mastery of an individual's talents through practice and application (Rath & Conchie, 2008). The CSF tool assists individuals in discovering their natural talents and provides a starting point for exploring them. As individuals learn about and explore their talents, they better understand how they can add value to a task rather than simply meeting expectations (Louis, 2012). The CSF has been employed in various ways to better understand the dynamics of the workplace and the development of strengths with students, families, and organizations (Asplund et al., 2014).

When participants complete the CSF, they are presented with an electronic survey that asks a series of questions related to common situations. For each question, participants are asked to rank how well various responses reflect their expected response to various situations. The responses to the common situations are related to one of 34 themes, termed a strength. When the participant completes the survey, themes are ranked from most to least prevalent, based on how the participant responded to each of the common situations presented. The top five themes are presented to the participant as their top five strengths (Asplund et al., 2014).

The reliability and validity of a testing methodology such as the CSF are important to understand before using such a method (Schreiner, 2006). Schreiner (2006) analyzed the results of the CSF with known valid and reliable psychological tests, such as the California Psychological Inventory (CPI) and the 16 Personality Factor (16PF) test. The CPI and 16PF were chosen as baseline comparisons because of their relatedness to the strengths provided in the CSF. Schreiner (2006) described the CSF as a tool appropriate for personal development and growth as well as for providing a foundation for college student development.

Strengths, GPA, and Success

Student retention and success has been widely studied. Student engagement is a common factor often connected to retention and success across many fields of study (Kahu & Nelson, 2018). On engagement, Furlong, Gilman, and Huebner (2014) and Seligman and Csikszentmihalyi (2000) described how strengths-based initiatives assist students in identifying their natural talents, which in turn lead to higher engagement in activities, further developing these talents. Further, Soria and Stubblefield (2015) found that first-year students with higher levels of strengths awareness, as measured by Anderson's (2004) strengths awareness measure instrument, were positively associated with higher levels of student retention. Even though published research has provided evidence that strengths may promote classroom engagement, student retention, and ultimately, academic success, existing research has not explored the "how" behind these findings. Specifically, whether higher levels of academic engagement and retention are driven by how effectively students use their strengths to support their academic success.

Limited research related to success in terms of GPA and CSF strengths in the field of engineering has been published. Lorimer and Davis (2015) found that students in an engineering program with more "engineering-oriented strengths" had a significantly higher GPA than those with fewer. The engineering-oriented strengths in Lorimer and Davis (2015) were defined as Clifton StrengthsFinder strengths paired with traits identified as abilities and expertise in the Engineer of 2020 published by the National Academy of Engineering (NAE, 2005). As an example, Analytical and Restorative strengths were paired with the attribute "analytical skills." Lorimer and Davis (2015) found that engineering students with more "engineering strengths" were more likely to earn a higher first year GPA.

There also has been limited research on the topic of how students use their strengths to be successful academically. Lopez and Louis (2009) described a strengths-based education approach that focuses on student talents to succeed rather than improving their "deficits." Cantwell (2006) shared a similar approach of building a classroom around each student's strengths. Schreiner (2010) described how the use of strengths in the classroom can move students from surviving and graduating to thriving in their programs. However, there is no descriptive or empirical measurement of

how students use their individual strengths in the classroom to improve their academic performance. This research aimed to partially address this gap in the literature.

Research Goals

The primary objective of this research was to identify how students are using their strengths to optimize their academic performance and if they perceived a connection between their CSF strengths and their success. This provides a baseline to understand how students are using the strengths-based educational model they have been taught to enhance their academic success. More specifically the research aimed to answer the following questions:

- How have students used their strengths during their academic experiences?
- What influence does student understanding and use of strengths have on student academic success?
- Do students perceive a relationship between use and understanding of strengths and student GPA?

METHODOLOGY

This research was reviewed by the institutional review board, IRB ID18-496, and was declared exempt from further review. A qualitative approach was used to gather information on student demographics and perceptions through a semi-structured interview. As part of the larger study, a survey was completed to drive interview questions and determine criteria for the selection of interview participants. This portion of the research was primarily unitized to gather more detailed feedback from students on their perceptions of the Clifton StrengthsFinder. The sample of participants was purposive to provide a representative from the groups participating in the survey portion of this research from the larger study. The sample intentionally included participants from each major type, engineering and technology, and from different genders to provide information that was representative of the department's population as Shown in Table 1. Juniors and Seniors were a targeted population to be interviewed as they were most able to speak to how they have utilized their strengths throughout their program.

Table 1. Participant Demographics

Technology	
Junior	1
Senior	4
Male	3
Female	2
Engineering	
Junior	0
Senior	3
Male	2
Female	1

A semi-structured interview was conducted with selected students to ask in-depth questions about how individuals used their strengths. In their review paper, Kallino, Pietilä, Johnson, and Kangasniemi (2016) described the semi-structured interview as a common qualitative data collection method that allows for versatility in the interview process by allowing the researcher to ask follow-up questions based on participant responses. The semi-structured interview process provided a flexible method of inquiry on student perceptions of strengths and success. In this research, participants were selected in a quota sampling method (Gideon, 2012). The sample intentionally included participants from all departmental majors in engineering and technology, and from different genders to provide information that was representative of the department's student population. The interview participants were selected based on criteria identified with an earlier survey, using a mostly convenience sample of departmental students who were approached and agreed to participate. Each interview was recorded and transcribed for analysis. Responses were summarized into themes for each participant. Initially, four pilot interviews were conducted with the purpose of determining if the interview was providing the needed information and to familiarize the interviewer with the interviewing process. Eight additional interviews were conducted after the pilot interviews.

Student use of strengths in academics

The first question in the interview asked participants to describe how useful strengths were in their academic coursework. The next several questions asked participants to describe situations where they used their strengths. Participants were then asked to characterize difficult and easy academic-related individual tasks without using any reference to strengths to determine if their responses aligned with their description of the

use of their strengths. Similarly, the participants were then asked to describe team-based tasks that were difficult and tasks that were easy, a question intended to elicit more information on how students used their strengths in a team environment. An example of questions posed as part of the student interview included: Can you describe a specific situation where you used your strengths and provide an example of a difficult and an easy course-related task?

Student perceptions of strengths and academic success

In the next portion of the interview, participants were also asked if they believed there were a set of strengths that influenced the level of success in their major or specific courses. Success was not explicitly defined for students. Rather, the question provided an opportunity to explore what the participant believed success was and how the strengths contributed to that success. To provide further student insights on success, participants were asked to describe characteristics of a successful student and a successful team.

RESULTS

Eight students were interviewed, five majoring in technology and three in engineering. Seven senior students and one junior student took part in the 30 to 60-minute semi-structured interview sessions.

Student use of strengths in academics

Interview participants were asked to describe situations where they thought strengths were useful as well as situations where strengths were not useful. Summarized in Figure 1., three of the participants stated that strengths were academically useful in some form, four did not perceive strengths to be academically useful, and one participant was indifferent on the subject and was undecided on the usefulness of strengths in terms of coursework. Of the three that perceived strengths as useful for academic work, two perceived strengths as only useful when working with others. One interviewee described strengths as being useful for individual work.

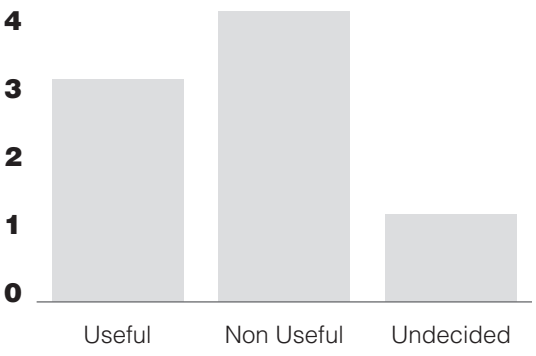

Figure 1. Student perceptions on usefulness of strengths in academics.

One individual noted that strengths are mostly useful when working in a group:

> *"I think that you can apply these more to like a group setting to get a group that would mesh better kind of play off each ethers strengths and weaknesses. I think just kind of like alone it still has value but, in my eyes, I think it loses its value outside of a group."*

Another participant had a different, more individualized, perspective:

> *"Because it allows me to attack the problem in the way that I know I am going to be able to understand and learn at the same time."*

Four participants characterized strengths as unnecessary to academic success, whether it was in group work or individual work. Of the three participants who perceived that strengths were unnecessary, all used the same reasoning to support their belief. These participants did not believe that knowing and understating one's strengths was necessary for success. They felt people already know what they are "good at" and strengths tests were just an educated way to describe these traits to others. For example, one participant stated:

> *"Your strengths are your strengths… they are just there; it doesn't matter if you're just putting a label on them… I know what I'm good at even if it's not classified in the StrengthsFinder and I know what I need to do to succeed."*

The fourth participant felt that strengths were only useful in the workplace and provided limited value elsewhere. Finally, one participant was indifferent on the subject had no strong opinion on the usefulness of strengths in coursework. A common perception for students who did not perceive strengths as helpful was less about the value of the strengths, but rather, a belief that individuals know their strengths and do not need an assessment tool to tell them the information.

The next interview question asked participants to describe a specific situation where they knew they were using their strengths. Six of the eight participants were able to clearly describe such a scenario. Participants described their use of strengths in the following areas:

- To improve processes at work and handle family situations
- To lead student clubs by communicating with people and in group projects to move everyone forward
- To resolve disputes within groups
- To stay on track with homework and planning ahead to complete coursework
- To take charge and make decisions in group projects with indecisive teammates
- To both relate to and include people in groups, repeatedly complete tasks at a high level, and adapt to new situations readily
- To find ways to talk through conflict resolution in group projects

The most repetitive theme across responses for this question was that the students chose to describe situations of working with others when they knew they were using their strengths. Figure 2. summarizes counts of where students mention they use their strengths.

The final interview question on how students are using their strengths asked participants to describe their approach to complete an easy and a difficult task. This question was used to determine if the individual described the application of their strengths for the chosen task. If the participant strengths were known from the interview, a connection between their description and their strengths was investigated. One of the participants described an easy task as one where they knew what they were doing. Because they knew what they were doing, their interest in the task encouraged individual research on the topic.

> *"I just got so deep into it and I studied outside of class and I put "studied" in quotations in that I looked up videos on what other people did and looked up "oh what does this one do" and "what's easier ways to do it" because the teacher kind of hinted at well there's an easier way to do this but I'm not going to tell you yet and it got me intrigued and so I figured it out before we were supposed to do it which in turn kind of helped me study."*

This situation describes how the participant was likely applying their Learner strength to seek out new information on the subject. Another participant with a Maximizer strength described tasks related to saving time and money as easy. Multiple participants described situations that didn't have explicit instructions or enough background material applied as being difficult. Following the CSF model of building teams with diverse strengths, lacking explicit instructions or information may make situations difficult for some people but can be seen as a non-issue for others.

Student perceptions of strengths and academic success

To determine if students perceived a connection between academic success and their knowledge of CSF strengths, participants were asked to describe a successful student and the characteristics of such a student. Of the eight interview participants, none mentioned GPA as an indicator of a successful student. Two of the participants specifically stated that grades were not a measure of success. One participant stated:

> *"I guess a successful student in my mind is just getting through and getting your degree. I know there's a lot of people that think a successful student is a 3.0 and there's a lot of companies that think that too, but I disagree."*

Six of the eight participants commented that a successful student effectively applied the learned material in their life after college. For example, one participant stated:

> *"I would describe a successful student an anyone who takes in the material and retains it as much as possible and leaves college with*

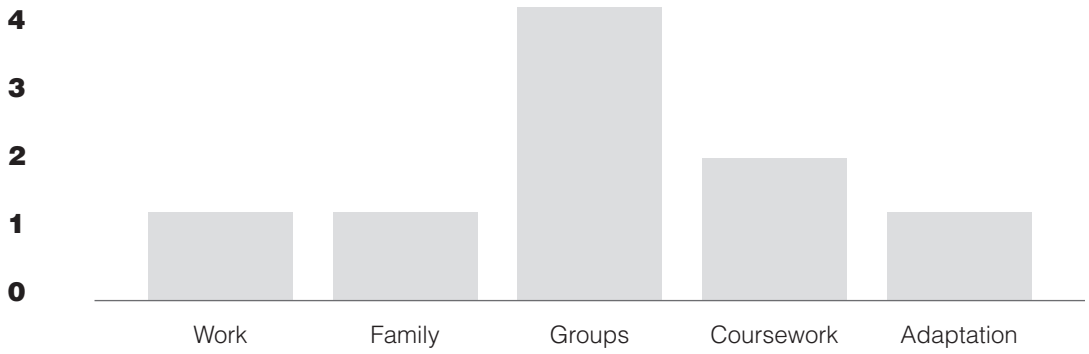

Figure 2. Frequency of where students mention the use of their strengths.

as much material and as much connections as they possibly could have gotten. I don't think grades are necessarily the most important thing in the world because anyone can get good grades it's really about did you actually learn something, was your time here worth it. If you weren't spending your time here to actually improve yourself then in my opinion it was wasted."

Participants described how a person was successful when learning. In the same way, one student stated that failing to learn something potentially helpful in the future was a waste of time. Overall, students did not perceive a connection between GPA and success. Although some participants could not name specific strengths that were related to success, they were able to describe the traits that they thought would make some students more successful than others. Strengths explicitly stated in the interviews included: strengths in strategic thinking such as ideation and adaptability. Strengths that aligned with traits described by participants included relator, analytical, command, and arranger. One of the participants described how success depends on the combination of one's strengths or how someone might use individual strengths in a unique way, rather than just having a specific set of strengths.

On the same topic of success, participants were asked to describe a successful team. A common theme among the responses was the ability to communicate effectively to get things done. Five participants mentioned that team members needed to be able to communicate about where each member of the team was strongest. In describing a successful team, one participant stated:

"I think regardless of your role, communication is what's going to make or break your team because you can have a bunch of people on there with different skills and everyone can play to those skills but if you're not communicating what those skills are and what you can do … well, you're probably just going to get whatever the group gives you and you may not be good at it and things can snowball from there."

Though there was no mention of strengths, participants who identified the ability to identify who was good at what when working together as part of a successful team were describing a strengths-based model. Similarly, in a previous question where students were asked to describe a situation where they knew they were using their strengths, students mentioned team tasks that would be relatable to strengths, but no specific strengths were mentioned in the previous responses. These interview responses provided information on how students readily identify "who is good at what." Yet, based on the data gathered as part of this study, it is clear they do not use CSF strengths to make these assessments.

DISCUSSION

Student use of strengths in academics

The primary focus of this research was to determine how students were using their strengths in their academic life. The interviews provided information from participants on how the strengths were being used in academics from the student perspective. In the interview, most participants did not describe strengths as being useful academically on an individual basis. Although only three of the participants described strengths as being useful academically, nearly all participants described a situation in which they used their strengths when working with others.

Further, information gathered from the interview was that even though students may not have perceived strengths as being useful in academics, they seemed to be using their strengths when working on group projects or working with others. Interview responses of students describing communication of abilities when working in teams was evidence of this.

When considering individual work, responses showed that the least frequent category where participants identified situations where they used their strengths were those focused on individual work. Though the CSF model is frequently used in the context of teams, it is also intended to be used on an individual basis (Asplund et al., 2014). Although previous data demonstrated that strengths impacted a student's confidence in individual work (Ryan, Mosher, & Freeman, 2020), few interviewees mentioned individual work or how individuals perceived the use of strengths in completing such work. Additionally, most of those interviewed did not emphasize specific situations where strengths have also been shown to apply (Ryan, Mosher, & Freeman, 2020), such as homework planning or adapting to new situations.

The majority of participants described the use of their strengths as part of working as part of a team or group. This result is likely most prevalent because when students work in teams, they often divide up the work based on individual student

expertise, which results from students actively identifying what they are good at. Though students likely use their strengths individually as well, students perceive teamwork to be the dominant area where they use them. To answer the question of how each student uses strengths in their academic experiences, it seems in this case, strengths are applied in a team or group setting. Therefore, although the interview responses suggest that students clearly use their strengths when working individually, the responses suggest the students primarily identify the use of strengths when working with others.

Student perceptions of strengths and academic success

Another major goal of this research was to identify if there was an influence on academic success due to the level of student use and understanding of strengths. To assist in the variation of what students perceive as academic success, the interview process allowed the participants to use their own definition of success. In the interview, participants were asked to describe a successful student. None of the participants described high GPA as indicator of a successful student. Success among the interview participants was generally defined by learning and application of that learning in the future. Participants described how they felt educators attempted to measure learning, but they did not perceive GPA as a valid measure of learning. When discussing teams, participants were asked to describe a successful team. Again, there was no mention of high grades or a high GPA. Instead, participants described successful teams as those that can work together and get things done. Though interview participants made no mention of strengths when discussing successful teams, participants did describe the importance of knowing what they and others were good at, suggesting that strengths play at least some role in team success. This aligns an earlier finding from the study, where strengths were found more useful to team and groupwork than to individual work.

Earlier evidence described how students perceive strengths to be most useful in teamwork. However, when interview participants were asked if there were a certain set of strengths that would predict higher levels of student success than others, all participants clearly responded that some strengths had more influence on success than others. This suggests that students did recognize the role strengths play in individual academic success, even when they were not able to clearly see the concept in their own learning.

In this research, the answer to the question of the role of student understanding and use of strengths have on academic success was dependent on whether students were working as an individual or with a team. With teams, students did not perceive a specific set of individual strengths as connected to success. Rather, they connected a simple awareness of strengths to success. In the context of teams, students describe how individuals were good at some things and as long as they could identify what tasks each individual on the team was good at, the team could be successful. On an individual level, students perceived that a specific set of strengths predicted student success. This suggests a contradictory thinking approach where participants perceive specific strengths as irrelevant to the success of teams, while they perceived a set of specific strengths as important to individual success.

Use and understanding of strengths

We know students communicate about abilities when working on teams, but we also know they are not using CSF strengths as part of this communication. We also know students do not perceive strengths as useful on an individual basis. With these two main understandings, we better know where to focus instructional efforts when teaching students about strengths and how to use them in the classroom and on the job. When students are learning about strengths, there should be more focus on how they can use them on an individual basis. Further, when students learn about strengths, there should be more emphasis on how they can be used to communicate with others clearly and concisely about what they are good at to build the strongest team. Rath and Conchie (2008) and others reported that diverse teams make better decisions and reach greater outcomes than teams whose members think alike. A better understanding of student strengths allow faculty to push each student to add their own value to teams they work on, whether in the classroom, on the job, or in their personal relationships.

CONCLUSIONS AND LIMITATIONS

Overall, this research has shown that students use and understand their strengths in their academic endeavors and perceive those strengths have some importance in their success, particularly as related to teamwork. Most students perceived that strengths were most useful when working with others to build successful teams. This perception aligns with Allen et al. (2013); Rath and Conchie (2008); Shimazoe and Aldrich 2010, who described how successful teams should be diverse

in strengths. Additionally, students describe the use of their strengths to complete tasks but are not actively aware that they are applying their strengths and do not describe those tasks with CSF strengths. If educators intend for students to use the knowledge of their CSF strengths, it is clear that there needs to be more direct application and guidance for the students in an academic setting.

The research was limited by several factors. This work took place with students from four majors in one department on one university campus. With the limited number of participants in this study, the findings are not generalizable to other departments, even those departments with similar characteristics, or institutions. The process and format of this process may be utilized elsewhere in the future in other locations with different students, but findings may vary from the current work. Further, this research is focused on a small window of students over the previous three years. Students and their perceptions can change and thus, the results of this type of research could change in the future.

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