

GIFTS: Cultivating Character Strengths in First-Year Engineering: From Awareness to Application

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Introduction: Motivation and Objectives

This Great Ideas for Teaching Students (GIFTS) paper presents an activity that supports first-year engineering students in identifying, applying, and developing their character strengths as part of their professional formation through team-based projects. Engineering education increasingly recognizes that developing technical proficiency alone is insufficient for preparing future engineers to address complex, human-centered challenges [1]. Character strengths such as perseverance, curiosity, fairness, and hope influence how students engage with problems, collaborate with peers, and persist through setbacks. However, many first-year students enter engineering programs without explicit frameworks for recognizing and leveraging their personal strengths. While research demonstrates that student-centered character development activities effectively engage students [2], scalable implementation approaches remain limited [3]. This paper presents an exploratory approach to cultivating character strengths awareness in first-year engineering.

At the University of Virginia School of Engineering and Applied Science, the Engineering Character Strengths Initiative supports faculty in embedding character exploration within their courses through shared resources and structured activities. As part of this initiative, the first-year engineering program has integrated character awareness into the Engineering Foundations curriculum. The present activity offers an adaptable approach that helps students connect character strengths to engineering design, teamwork, and professional growth. The model engages students in identifying their own strengths, recognizing character strengths in action, and exploring how these traits develop within collaborative settings.

The objectives are to (1) increase students' awareness of their character strengths and understanding of how these qualities shape their learning and collaboration, (2) support intentional application of strengths in team-based design projects, and (3) foster a growth mindset through structured reflection on personal and professional development.

Implementation

This model consists of three main components designed to progressively deepen students' engagement with character strengths. First, students completed the Values In Action (VIA) Character Strengths Survey prior to class to identify their top five strengths [4]. The VIA classification, developed by Peterson and Seligman [5], clearly defines 24 character strengths, establishing common language for discussion. VIA was chosen for its accessibility and empirical validation. It serves as a school-wide entry point for character education, with shared vocabulary intended to support students' engagement with virtue-based engineering ethics topics in their second-year Engineering Ethics course.

Second, students watched "October Sky", a film based on the true story of four high school students passionate about rocketry who face technical setbacks and community opposition. Guided discussions encouraged students to analyze how character traits such as perseverance

through failed launches, leadership amid conflict, and teamwork under pressure influenced decisions and outcomes, and to consider how their own strengths might inform their actions in similar situations (Appendix A). This concrete example makes character awareness more meaningful by demonstrating how character informs decision-making and team success.

Third, students reflected on their strengths throughout team-based design activities. When forming teams, they defined character strengths of an ideal teammate (e.g. “honesty” and “creativity”) and identified when these traits appeared in practice. Throughout various design challenges, students revisited these strengths, examining their prevalence and impact, and identifying areas for improvement (e.g., practicing “gratitude” to improve team climate). This approach strengthens character awareness by providing immediate opportunities to practice character in action.

Assessment and Results

We employed two surveys (Appendix B) as exploratory measures of perceived awareness and application. Survey 1, conducted after the VIA assessment and film discussion at the beginning of the semester, measured students’ initial awareness of their character strengths and their anticipated application of these qualities. Survey 2, administered after team projects at the end of the semester, measured students’ reflective assessment of actual application and ability to generalize awareness across diverse academic and co-curricular contexts.

Open-ended responses were analyzed using inductive thematic coding by two researchers. Initial codes were developed independently, then refined through consensus discussion to identify patterns in strength-context pairings and development priorities. Microsoft Copilot was utilized to assist in identifying preliminary themes with manual reliability checks and researcher consensus throughout the process. (The study was approved by the university’s Institutional Review Board, Protocol #6614.)

Among 48 participants who provided complete responses at both timepoints, the most frequently identified character strengths were kindness, curiosity, fairness and honesty, with perspective becoming more common by semester’s end (Figure 1).

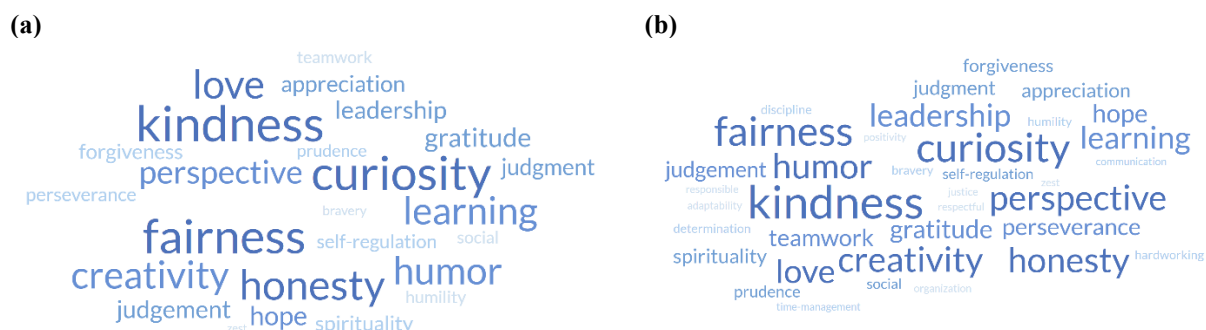


Figure 1. Top five character strengths students identified (a) at the beginning and (b) at the end of the semester (n = 48)

Both surveys used four parallel Likert-scale items assessing: ability to identify and articulate how strengths influenced learning, awareness of applicable situations, intentional application in

coursework/teamwork, and use in co-curricular activities (Figure 2). Wilcoxon signed-rank tests were conducted to compare Survey 1 and Survey 2 responses ($n = 50$, paired data). Results revealed no significant differences between anticipated and actual ability to identify and articulate how their strengths influenced their learning ($p > 0.999$) or awareness of applicable situations ($p = 0.827$). However, self-reported intentionality in applying strengths in coursework and teamwork and use of strengths in co-curricular activities were significantly lower than their initial expectations ($p = 0.018$ for both).

Students maintained consistent awareness and understanding of their character strengths from early aspirational thinking through end-of-semester reflection, indicating that the initial intervention successfully established foundational knowledge that persisted throughout authentic engineering experiences. The gap between initial expectations and end-of-semester self-reported application in both course contexts and co-curricular activities suggests that character strengths awareness requires explicit scaffolding and ongoing prompting to translate into sustained intentional practice.

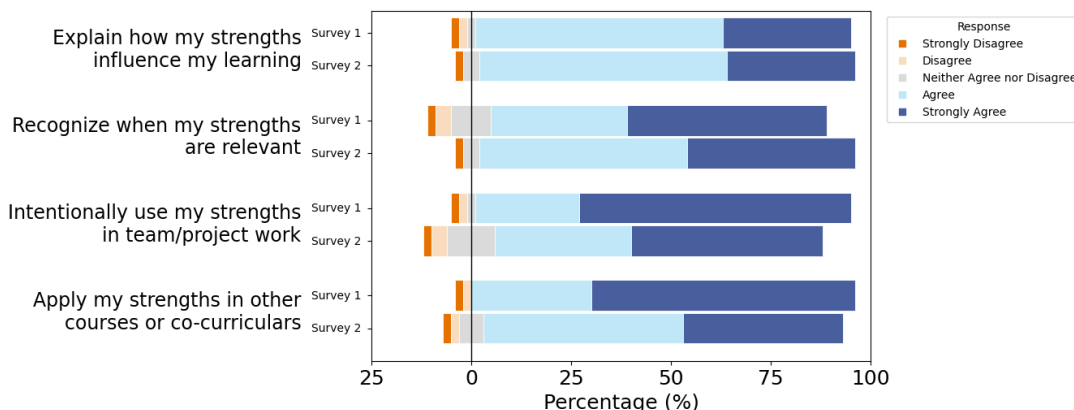


Figure 2. Comparison of character strengths awareness and application at the beginning vs. at the end of the semester

Open-ended responses provide qualitative evidence of how students applied their character strengths in practice and which strengths they prioritized for further development. Analysis of these responses revealed both consistencies and shifts in how students connected specific strengths to engineering contexts.

Application of strengths in engineering contexts

Students consistently identified creativity, curiosity, and love of learning as strengths essential to engineering design, recognizing that these strengths enhance conceptual understanding and fuel creative problem solving. Kindness and teamwork were consistently mentioned as traits important for collaboration and group dynamics. Notable differences emerged over the semester: students initially anticipated applying fairness to enhance group climate, yet this strength-context pairing was absent from end-of-semester reflections. Conversely, by semester's end, student responses highlighted a new appreciation for leadership in taking initiative and for perseverance, specifically in the context of prototyping. This shift suggests that hands-on design experiences revealed the importance of these strengths in ways that were not initially anticipated.

Development of character strengths

Similar patterns of consistency and evolution appeared in responses regarding strengths students hoped to develop or reflected on developing. Teamwork, curiosity, and creativity were consistently mentioned across both timepoints, reinforcing their perceived importance in engineering education. However, students' understanding of perseverance evolved notably throughout the semester. Initially, students hoped to develop perseverance primarily in the context of handling failure and setbacks. By semester's end, their reflections focused more specifically on perseverance through the iterative prototyping process. This shift highlights prototyping as both a common and unexpected challenge for first-year students and a meaningful context for practicing perseverance, while underscoring the importance of iteration in engineering design. The specificity of end-of-semester responses suggests that students developed a more nuanced, contextual understanding of how character strengths manifest in authentic engineering work.

Conclusion and Discussion

This activity demonstrates how structured character strengths integration helps students recognize character development alongside technical learning in first-year engineering education. By embedding the VIA assessment, shared narrative experiences, and ongoing reflection within team-based activities, the intervention helped students see themselves as engineers in formation.

Students maintained stable awareness of their character strengths throughout the semester, indicating initial activities successfully established foundational knowledge. However, self-reported intentionality in applying strengths was significantly lower than initial expectations in both course-related and co-curricular contexts, suggesting a shift from aspirational thinking to more realistic self-assessment. Qualitative data support this interpretation – students demonstrated increasingly sophisticated understanding of character in practice, evolving from fairness-focused expectations to recognizing the importance of perseverance and leadership in prototyping. Students discovered which strengths matter most through practice rather than prediction. This pattern suggests that metacognitive scaffolding might help students maintain conscious awareness of their character strengths even as those strengths become more naturally integrated into practice.

Surveys were locally developed exploratory measures, not validated instruments. Self-reported data may not capture unconscious strength application. Future implementations could explore periodic reflection checkpoints throughout design projects and explicit coordination across courses to better support transfer beyond the initial course context. Longitudinal studies tracking how character awareness influences academic performance, career choices, and professional behavior would be valuable. Alternative frameworks (e.g., Jubilee Framework [6]) offer complementary approaches worth exploring.

By combining evidence-based assessment, shared narrative experiences, and embedded reflection within team-based activities, this model offers an approachable and scalable pathway for integrating character exploration into early engineering education.

Acknowledgement

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Appendix A: Character Strengths and October Sky Activity

You watched *October Sky* and completed the VIA Character Strengths survey. Today's activity connects the film to your own strengths and to your growth as a learner in engineering.

Instructions

1. **Form Groups:** Work in groups of 3 – 4 students.
2. **Choose a Scenario:** Your group will be provided with a set of scenarios from *October Sky*. Select one scenario to analyze.
3. **Discuss the Prompts:** As a group, discuss and record your thoughts on the following:
 - 1) **Identify Strengths**
 - a. Which character strengths were expressed by each person in the scenario?
 - b. How did they show up (specific words, actions, decisions)?
 - 2) **Impact of Strengths:** How did these strengths influence other people and shape the outcomes?
 - 3) **Personal Reflection:** Put yourself in this scenario.
 - a. What would you have done?
 - b. How do your own top character strengths (from your VIA survey) connect to your actions?
 - c. If your actions differed, how might the outcomes have been different?
4. **Share Out:** Share highlights of your group's discussion with the class.

Scenario 1 – Homer and His Father's Conflict

Characters to consider: Homer, John, Elsie

Scenario 2 – Miss Riley's Encouragement

Characters to consider: Miss Riley, Homer, Mr. Turner

Scenario 3 – The First Rocket Launch

Characters to consider: Homer, Quentin, Roy Lee, O'Dell, townspeople

Scenario 4 – The Coal Mine Accident

Characters to consider: Homer, John, Ike Bykovsky

Scenario 5 – The Science Fair Success

Characters to consider: Homer and team, Mr. Bolden, Elsie, townspeople

Some characters from the film:

- **Homer Hickam Jr. (Sonny)** – main character, inspired by Sputnik to build rockets.
- **Quentin Wilson** – the "math/science geek" of the group.
- **Roy Lee Cooke** – Homer's friend who provides transportation for the group.
- **O'Dell Carroll** – a resourceful friend who helps the group gather supplies.
- **John Hickam** – Homer's father, coal mine foreman.
- **Elsie Hickam** – Homer's mother, supportive of his dreams.
- **Jim Hickam** – Homer's older brother, star football player.
- **Miss Riley** – dedicated teacher who encourages the Rocket Boys.
- **Mr. Turner** – school principal, initially skeptical.
- **Ike Bykovsky** – machinist at the mine who helps with rocket building.
- **Mr. Bolden** – machinist, helps the boys with their nozzle.

Values in Action (VIA) Character Strengths List

Wisdom & Knowledge (cognitive strengths)

1. **Creativity** – Original & Adaptive, Clever, A problem solver, Sees and does things in different ways
2. **Curiosity** – Interested, Explores new things, Open to new ideas
3. **Judgment** – A critical thinker, Thinks things through, Open minded
4. **Love of Learning** – Masters new skills & topics, Systematically adds to knowledge
5. **Perspective** – Wise, Provides wise counsel, Takes the big picture view

Courage (emotional strengths)

6. **Bravery** – Shows valor, Doesn't shrink from fear, Speaks up for what's right
7. **Honesty** – Authentic, Trustworthy, Sincere
8. **Perseverance** – Persistent, Industrious, Finishes what one starts
9. **Zest** – Enthusiastic, Energetic, Doesn't do things half-heartedly

Humanity (interpersonal strengths)

10. **Love** – Warm and genuine, Values close relationships
11. **Kindness** – Generous, Nurturing, Caring, Compassionate, Altruistic
12. **Social Intelligence** – Aware of the motives and feelings of others, Knows what makes others tick

Justice (civic strengths)

13. **Teamwork** – Team player, Socially responsible, Loyal
14. **Fairness** – Just, Doesn't let feelings bias decisions about others
15. **Leadership** – Organizes group activities, Encourages a group to get things done

Temperance (strengths that protect against excess)

16. **Forgiveness** – Merciful, Accepts others' shortcomings, Gives people a second chance
17. **Humility** – Modest, Lets one's accomplishments speak for themselves
18. **Prudence** – Careful, Cautious, Doesn't take undue risk
19. **Self-Regulation** – Self-controlled, Manages impulses and emotions

Transcendence (strengths that connect us to larger meaning)

20. **Appreciation of Beauty & Excellence** – Feels awe & wonder in beauty, Inspired by goodness of others
21. **Gratitude** – Thankful for the good, Expresses thanks, Feels blessed
22. **Hope** – Optimistic, Future-minded
23. **Humor** – Playful, Brings smiles to others, Lighthearted
24. **Spirituality** – Searches for meaning, Feels a sense of purpose, Senses a relationship with the sacred

Appendix B: Character Strengths Survey Questions

Survey 1: at the beginning of the semester after the character strengths activities

1. List your top five VIA character strengths.
2. Please indicate the extent to which you agree with the following statements.
 - Right now, I can explain how my top strengths might influence my learning in Engineering Foundations.
 - Right now, I can anticipate situations in Engineering Foundations where my strengths will be relevant.
 - I plan to intentionally use my strengths in team/project tasks (e.g., planning, prototyping, testing, presenting, communication).
 - I expect to use these strengths in other courses or co-curriculars this term.
3. Which character strengths do you expect to use in Engineering Foundations, and in what situations?
4. Which character strengths do you hope to explore or develop further this semester, and why?

Survey 2: at the end of the semester

1. List your top five VIA character strengths (if they changed, list the new ones)
2. Please indicate the extent to which you agree with the following statements.
 - Looking back, I can clearly explain how my top strengths influenced how I learned and worked in Engineering Foundations.
 - Over the semester, I recognized situations where my strengths were relevant.
 - I intentionally used my strengths in team/project tasks (e.g., planning, prototyping, testing, presenting, communication, teamwork).
 - I used these strengths in other courses or co-curriculars this term.
3. What character strengths have you applied in Engineering Foundations, and in what situations? How did you apply them?
4. What character strengths have you explored or developed further? Through what coursework or activities did you develop those?