WIP: A Multi-tiered Strategy to Increase Freshman Retention

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Introduction

This work-in-progress paper focuses on a redesigned first-year experience (FYE) program at Wichita State University, aimed at increasing student success and retention. While the retention of undergraduate engineering students is essential for addressing the global demand for qualified engineers, first-year retention rates remain a significant challenge. This paper will explore how the redesigned program addresses this challenge.

Initially, a project-based Engineering 101 course was revamped in 2016 but showed limited improvement in retention rates, stabilizing around the mid-60% range. In 2021, the program was further restructured into a comprehensive, multi-semester experience named the “Shocker Design Experience," expanding its scope to include students of all majors.

The redesigned program integrates the Kern Entrepreneurial Engineering Network (KEEN) Entrepreneurial Mindset framework, emphasizing curiosity, connections, and creating value [1], with Stanford d.school’s Design Thinking model [2]. This approach engages first-year students through multidisciplinary teamwork, peer mentorship, and professional competency workshops, aiming to nurture both academic success and lifelong learning skills.

Preliminary results reveal promising trends, with retention rates increasing to 77% in the academic year 2022-2023, representing a significant improvement over prior iterations and exceeding the college’s average by 6% and the university’s average by 5%.

This study further explores the correlation between program components and their influence on retention and examines the following research questions:

- RQ1: How much has this redesigned FYE increased student retention?
- RQ2: Are students who continue to the spring semester retained at a higher rate?
- RQ3: To what extent does participation in the redesigned program increase students’ self-reported dimensions of curiosity?
- RQ4: How does the curiosity level compare between retained students and those not retained?

Project Approach

The Shocker Design Experience program represents a two-semester, multidisciplinary first-year initiative designed for scalability.

The program is structured as follows:

- Fall Semester: Students take a three-credit hour first-year seminar course called Introduction to Technology and Innovation, where students learn the fundamentals of human-centered design. Approximately 450 students enroll in the fall semester; they meet in sections of 24 students.
- Spring Semester: Students have the option to continue with their team in an optional one-credit hour applied project course to incorporate the application of entrepreneurial

mindset and business skills and turn their big idea venture into a working prototype and business model canvas, culminating in an innovation competition. Approximately 200 students continue to the spring semester; they meet in sections of 24 students.
- First-year Capstone Competition: Students deliver an elevator pitch at the competition, presenting their working prototype and business model canvas to judges. The winning team advances to a national elevator pitch competition.

Key Pedagogical Strategies

This program employs three key pedagogical strategies, in addition to the normal coursework:

1. **Multidisciplinary Team Projects:** Student teams engage in problem-based learning through a semester-long project. Multidisciplinary teams are formed early in the fall semester and persist throughout the program, fostering sustained collaboration and skill development. Teams are guided to develop and execute project charters, agendas, and schedules. Teamwork skills are reinforced using frameworks like the Table Group's Working Genius [3], emphasizing identifying and leveraging each team member's natural strengths. Utilizing multidisciplinary teams not only enhances team performance and innovation [4] but can also contribute to higher retention rates by making the study environment more engaging, relevant, supportive, and adaptable.
2. **Peer Mentor Program:** Peer mentors, who are former program participants, provide guidance, encouragement, and support to incoming students. Mentors receive specialized training in leadership and facilitation to optimize their effectiveness. Mentors meet with student teams once per week to help them stay on schedule with their project. Studies show that peer mentorship programs help increase retention rates by offering guidance and support, making students feel more connected and less likely to drop out [5].
3. **Professional Competency Workshops:** Workshops address essential academic and career readiness skills. Topics range from student success strategies to industry insights, delivered by campus leaders and local professionals. Workshops offer students the opportunity to gain new perspectives, enhance their self-awareness, and build confidence in their abilities, which are all crucial for academic and career success [6].

These strategies are grounded in established educational frameworks to maximize engagement and retention. Additionally, the program is aligned with institutional goals for interdisciplinary education and workforce readiness.

Emphasis on Curiosity

The course places special emphasis on improving students' curiosity because it is shown that increasing curiosity can lead to improvements in creativity, innovation, academic performance, and life satisfaction [7]. Additionally, KEEN states that curiosity is an important skillset for engineers to develop to be engaged in their course work and adapt to the changing world around them [1]. In their study on integrating Entrepreneurial Mindset Learning (EML) into first-year engineering courses, KEEN colleagues found that integrating concepts of the entrepreneurial mindset, including curiosity, led to improvements in their students' abilities to meet technical learning objectives [8].

Strategies to Support Curiosity

The following strategies are woven into the students' coursework to support the growth and development of curiosity:

- Active learning in the classroom stimulates curiosity by encouraging students to ask questions and explore ideas through mini design challenges and class discussions about the book *How We Got to Now* [9], which explores the innovative breakthroughs that have shaped our modern world.
- Problem-based learning helps students practice dealing with ambiguity and creates opportunities for exploration and discovery [1].
- Design Thinking process encourages students to be curious about user needs, build empathy for their customers by conducting interviews to understand the needs, and explore different design solutions [2].
- Professional Competency Workshops encourage students to learn about new topics and improve their lifelong learning skills [6].

Following in the work of the same KEEN colleagues previously mentioned [8], an assessment of student curiosity was added into this revised program, using Kashdan's Five-Dimensional Curiosity Scale [10] in a pre- and post-course survey. Questions from the survey are given in the Appendix.

Curriculum Mapping

A curriculum map was then created to ensure alignment between the three key pedagogical strategies and the curiosity assessment, shown in Table 1. Each key strategy maps to multiple curiosity dimensions.

Multidisciplinary Teams: Align to Deprivation Sensitivity, Stress Tolerance, and Thrill Seeking. For Deprivation Sensitivity, we give students an opportunity to practice dealing with ambiguity. The first six weeks of the semester we give students team-based entrepreneurial mindset mini-design challenges that intentionally force them to solve problems without having all the information up front. They gradually learn to ask better questions and become less uncomfortable taking on these challenges. For Stress Tolerance, we give their team a challenge to identify their own course project. Student teams must venture out into the community to interview people to identify a need they can solve using technology; this is an undefined problem to solve where they must conduct several interviews and library research to gather the appropriate information, with guidance from faculty and peer mentors. For Thrill Seeking, student teams also learn to use makerspace equipment to turn their solution idea into a working prototype; most students have not used hand tools, let alone large machinery with lasers or moving blades. Students try new things and build their confidence.

Peer Mentors: Aligns to Joyous Exploration, Stress Tolerance, and Social Curiosity. For Joyous Exploration, our peer mentors meet with teams weekly to facilitate each step of the project process and guide them on the weekly team homework. For Stress Tolerance, the mentors provide encouragement as someone who has experience with the course and with campus; they also help students to build a growth mindset as they encounter new situations in their first

semester. For Social Curiosity, peer mentors also mentor students to get involved on campus, facilitate conflict resolution between team members, and take time to get to know each student on the teams they mentor.

Professional Competency Workshops: Align to Joyous Exploration and Social Curiosity. For Joyous Exploration, we include a wide spectrum of student success topics (time management, note taking, information literacy, etc.), psychology topics, and workforce skills (problem solving, critical thinking, innovation and creativity, etc.). We utilize in-person guest speakers from across campus and offer asynchronous workshops using TED Talks and LinkedIn Learning. For Social Curiosity, these workshops are taught in a small group setting and encourage interaction with students from outside their course section.

Table 1: Curriculum map showing alignment of key strategies with curiosity dimensions.

Kashdan's Curiosity Dimensions	Multidisciplinary Teams	Peer Mentors	Professional Competency Workshops
Joyous Exploration	-	X	X
Deprivation Sensitivity	X	-	-
Stress Tolerance	X	X	-
Social Curiosity	-	X	X
Thrill Seeking	X	-	-

Methods

This paper includes three analysis methods: percentages to measure retention rates, paired t-test to compare pre- and post-surveys on self-reported curiosity measures, and binary logistic regression to examine the relationship between curiosity to retention rates.

Percentages: Since the academic year 2021-2022, retention rates have been tracked from year to year and from term to term [11]. Results are shown in Table 2 and Table 3, respectively. A list of students enrolled in our courses is downloaded from the university's database on the 20th day of enrollment. This data collection also includes major and demographic information. The system can run reports to show the current enrollment status of each student. Thus, each student is tracked semester to semester and marked as enrolled or not. Wichita State is an urban-serving institution in Wichita, Kansas, the largest city in the state of Kansas; the student population of our course reflects the diversity of the university, including a significant number of first-generation students, increasing Hispanic population, and urban and rural students from all along the I-35 corridor from Kansas to Texas.

Paired t-Test: Student curiosity was measured using Kashdan's Five-Dimensional Curiosity Scale [10] in a pre- and post-course survey. First, the scale for each dimension was validated. Using Microsoft Excel, statistical analysis was conducted using a t-Test: Paired Sample for Two Means to compare the means of each dimension in the pre- and post-course survey, with results shown in Table 4. The hypothesized mean difference was set to zero, meaning no change or improvement was expected. Values in bold are statistically significant ($p < 0.05$). Students were

asked to complete the survey as graded homework to ensure higher completion rates. Total student population is reported in Table 2, and curiosity survey sample size by year is shown in Table 4; only students who completed both the pre- and post- survey and who answered all questions in the survey were included in the statistics.

Regression: A binary logistic regression was performed using Minitab software and is shown in Table 5. This regression was used to examine the relationship between changes in curiosity and retention. Retention was coded as 0 (not retained) and 1 (retained). The response event was set as 1 for retained. There are two continuous predictors: the pre-course curiosity score and the change in curiosity score (to help address potential issues of regression to the mean). Curiosity change scores were calculated as the difference between post-course and pre-course curiosity scores.

Results and Discussion

The program began in 2021 with 149 students (90% engineers), scaling to 445 participants (70% engineers) in 2023.

Retention Results

RQ1: How much has this redesigned FYE increased student retention?

Table 2 shows the total number of students enrolled in the fall semester by the 20th day of classes, and the percentage of those students who were enrolled in the following fall semester. Engineering students are reviewed separately for comparison. The college's average retention rate is included for comparison. The analysis is described in the Methods section.

It is important to note that these four years in Table 2 have the exact same course content, but they have some differences in instructional methods:

- 2020-2021: This pre-intervention year serves as our control group. There was a multidisciplinary team project, but no peer mentors or workshops. Five instructors.
- 2021-2022: Official pilot year with only two instructors. A flipped classroom and flexible, self-paced conference-like schedule was tried. Offered in-person and asynchronous professional development workshops. The team project was the same.
- 2022-2023: First year to increase scale, still with two instructors. Returned to a typical course schedule, where one of the two weekly in-person class sessions was a lecture with active learning and hands-on activities, and the other class day was a team meeting with a peer mentor at a different location on campus.
- 2023-2024: Continued exactly as 2022-2023.

Key findings:

- Retention is indeed increasing year over year in this redesigned program, up to 77% from mid-60% originally.
- Retention is increasing as scale is increasing, which seems counterintuitive (recall that students meet in sections of 24, not all together at the same time).
- Higher retention among engineering majors (79% in 2022-2023 and 80% in 2023-2024) compared to non-engineering participants, as seen in Table 2.

Table 2: Retention of freshman year to sophomore year for students who completed the fall course in this program.

Academic Year	Participating Students in Fall Course	Overall Retention Rate to Sophomore	Engineering Majors Students	Retention Rate for Engineering Students	College Average Retention
*2020-2021**	*106*	*58%*	-	-	-
2021-2022	149	73%	-	-	71%
2022-2023	328	77%	199	79%	71%
2023-2024	445	77%	242	80%	71%

**Data from 2020-2021 was not recorded at the time and is not readily available in our institution's learning management program. This data reflects the correct enrollment, but the retention percentage reflects students who were awarded degrees.*

RQ2: Are students who continue to the spring semester retained at a higher rate?

Students have the option to continue with their team with the same product idea, continue with their team but change their product idea, or change teams altogether. Student teams meet bi-weekly with the instructors and have weekly check-ins with peer mentors. Students who complete this semester earn additional applied learning experience credit towards graduation.

Key findings:

- Greater persistence and retention among students completing both semesters versus those completing only the fall course, as seen in Table 3.

Table 3: Retention of freshman who continued into the second semester spring applied project course to sophomore year.

Academic Year	Participating Students in Spring Applied Project Course	Overall Retention Rate to Sophomore	Engineering Majors Students	Retention Rate for Engineering Students	College Average Retention
2021-2022	110	83%	-	-	71%
2022-2023	155	93%	135	92%	71%
2023-2024	160	85%	121	85%	71%

Curiosity Results

RQ3: To what extent does participation in the redesigned program increase students' self-reported dimensions of curiosity?

Student curiosity was measured using Kashdan's Five-Dimensional Curiosity Scale [10] in a pre- and post-course survey, and the analysis is described in the Methods section.

Key findings:

- Overall, we observe an increase in statistically significant results year over year, with all categories showing improvement in 2024.
- Notably, in 2024, the most improved areas are Stress Tolerance, followed by Social Curiosity, then Deprivation Sensitivity. These areas show students developing a growth mindset to overcome doubt, interacting more with their peers, and building confidence to endure new experiences. This increase in curiosity, specifically in these three areas, is a strong indicator of persistence and retention.

Table 4: T-Test results comparing means of pre- and post-survey curiosity dimensions.

	2022 (n=113)				**2023 (n=269)**				**2024 (n=266)**			
Curiosity Dim.	**Pre**	**Post**	**Delta**	**SD**	**Pre**	**Post**	**Delta**	**SD**	**Pre**	**Post**	**Delta**	**SD**
Joyous Exploration	5.19	5.29	0.10	0.91	5.35	5.49	**0.14**	0.84	5.36	5.50	**0.13**	0.88
Deprivation Sensitivity	4.96	5.07	0.11	0.95	4.89	4.91	0.02	1.18	4.83	5.05	**0.22**	1.09
Stress Tolerance*	4.74	4.16	**-0.58**	**1.19**	3.48	3.77	**0.29**	1.28	4.68	4.40	**-0.28**	1.24
Social Curiosity	4.74	4.67	-0.07	1.11	4.75	4.93	**0.19**	1.17	4.79	5.06	**0.27**	1.10
Thrill Seeking	4.11	4.23	0.12	1.02	4.21	4.29	0.07	1.12	4.25	4.38	**0.13**	1.09

**Note that Stress Tolerance is reverse scored, thus a negative value indicates improvement.*

RQ4: How does the curiosity level compare between retained students and those not retained?

A binary logistic regression was performed using Minitab software and is shown in Table 5. The analysis is described in the Methods section. Note that an odds ratio (OR) greater than 1 indicates that an increase in the predictor (increased curiosity) is associated with an increase in the odds of the response event (retention).

Key Findings:

- Students who showed a greater increase in curiosity from pre- to post-course were significantly more likely to be retained (OR = 1.87, 95% CI [1.23, 2.82], p = 0.003).
- The odds ratio for the curiosity change score was 1.87, indicating that for every one-unit increase in curiosity score, the odds of being retained increased by 87%.
- The Hosmer-Lemeshow test indicated a good fit of the model to the data ($\chi^2(8) = 4.95$, $p = 0.763$, thus $p > 0.05$).

Table 5: Binary logistic regression results of relationship between changes in curiosity and retention.

Variable Name	**Coef**	**SE Coef**	**Z-Value**	**P-Value**	**Odds Ratio**	**95% CI**
Constant	0.887	1.02	0.864	0.305	--	--
Curiosity Pre-Course Survey	0.211	0.184	1.12	0.251	1.2351	(0.8615, 1.7707)
Curiosity Change Score	0.627	0.297	2.61	0.003	1.8715	(1.2378, 2.8298)

Future Studies

Analysis of our data reveals a positive correlation between student curiosity, retention, and the integrated implementation of multidisciplinary teamwork, peer mentorship, and professional competency workshops.

After three years of this redesigned program, some early long-term effects are being noted, including increased enrollment in the upper-level courses (due to retention of students from this program), positive feedback from upper-level instructors that these retained students are better prepared to take on and manage team projects, and higher quality senior capstone performance. Data is currently being collected to document these impacts.

The next step of this study is to identify causative factors that impact retention in this program. The following research questions will be examined in future ASEE papers building off this study:

- How do specific components of the redesigned FYE program (e.g., multidisciplinary teams, mentoring, professional competency workshops) contribute to student retention?
- Does the program's impact on retention vary across different student demographics (e.g., underserved students, major, GPA, academic preparation before college)?
- How does the development of curiosity throughout the first year relate to students' academic performance and their engagement in extracurricular engineering activities?
- How can we measure the other components of the KEEN 3C's (connections, creating value) to ensure students develop a well-rounded entrepreneurial mindset?

A mixed-methods approach will be beneficial to gain a more comprehensive understanding of the factors influencing retention. While this paper reviews some quantitative data (retention rates, curiosity survey scores), future papers will evaluate qualitative data (student interviews and focus groups).

In addition, a longitudinal study is being planned to track students' progress over multiple years to assess the long-term impact of the FYE program on retention and graduation rates. We do have limited graduation data from 2020-2021 in Table 2 and will expand on this for future studies.

Appendix 1

Kashdan's Five-Dimensional Curiosity Scale [10].

Questions used in the survey are listed below:

Joyous Exploration:
1. I view challenging situations as an opportunity to grow and learn.
2. I am always looking for experiences that challenge how I think about myself and the world.
3. I seek out situations where it is likely that I will have to think in depth about something.
4. I enjoy learning about subjects that are unfamiliar to me.
5. I find it fascinating to learn new information.

Deprivation Sensitivity:
1. Thinking about solutions to difficult conceptual problems can keep me awake at night.
2. I can spend hours on a single problem because I just can't rest without knowing the answer.
3. I feel frustrated if I can't figure out the solution to a problem, so I work even harder to solve it.
4. I work relentlessly at problems that I feel must be solved.
5. It frustrates me not having all the information I need.

Stress Tolerance - reverse scored:
11. The smallest doubt can stop me from seeking out new experiences.
12. I cannot handle the stress that comes from entering uncertain situations.
13. I find it hard to explore new places when I lack confidence in my abilities.
14. I cannot function well if I am unsure whether a new experience is safe.
15. It is difficult to concentrate when there is a possibility that I will be taken by surprise.

Social Curiosity:
16. I like to learn about the habits of others.
17. I like finding out why people behave the way they do.
18. When other people are having a conversation, I like to find out what it's about.
19. When around other people, I like listening to their conversations.
20. When people quarrel, I like to know what's going on.

Thrill Seeking:
21. The anxiety of doing something new makes me feel excited and alive.
22. Risk-taking is exciting to me.
23. When I have free time, I want to do things that are a little scary.
24. Creating an adventure as I go is much more appealing than a planned adventure.
25. I prefer friends who are excitingly unpredictable.

References

[1] “The KEEN framework” Engineering Unleashed, 2025, https://engineeringunleashed.com/framework.

[2] “Start with design,” Hasso Plattner Institute of Design at Stanford University, 2025, https://dschool.stanford.edu/resources/get-started-with-design.

[3] P. Lencioni, The 6 types of working genius: A better way to understand your gifts, your frustrations, and your team. Dallas, TX: Matt Holt Books, an imprint of BenBella Books, Inc, 2022.

[4] D. Fay, C. Borrill, Z. Amir, R. Haward, and M. A. West, “Getting the most out of multidisciplinary teams: A multi-sample study of team innovation in health care,” Journal of Occupational and Organizational Psychology, vol. 79, no. 4, pp. 553–567, Dec. 2006.

[5] H.-G. Le, S. Sok, and K. Heng, “The benefits of peer mentoring in higher education: findings from a systematic review,” Journal of Learning Development in Higher Education, no. 31, Sep. 2024, https://doi.org/10.47408/jldhe.vi31.1159.

[6] V. Bruni-Bossio and M. Delbaere, “Not everything important is taught in the classroom: Using cocurricular professional development workshops to enhance student careers,” Journal of Management Education, vol. 45, no. 2, p. 105256292092906, Jun. 2020, doi: https://doi.org/10.1177/1052562920929060.

[7] N. S. Schutte and J. M. Malouff, “A meta-analytic investigation of the impact of curiosity-enhancing interventions,” Current Psychology, May 2022, doi: https://doi.org/10.1007/s12144-022-03107-w.

[8] D. Grzybowski, A. Leonard, T. Alexia, D. Tang, and K. Zhao, "Curiosity improves in EML infused 1st year engineering design/build course," Engineering Unleashed, November 2021. https://engineeringunleashed.com/card/819.

[9] Johnson, S., & Keenan, S. (2018). How we got to now: Six innovations that made the modern world. VIKING, Published by Penguin Group.

[10] T. B. Kashdan, et al., “The five-dimensional curiosity scale: Capturing the bandwidth of curiosity and identifying four unique subgroups of curious people,” Journal of Research in Personality, vol. 73, pp. 130–149, Apr. 2018, https://doi.org/10.1016/j.jrp.2017.11.011.

[11] [School Mascot] Design Experience Program Documentation, January 2025, Internal program records.