Understanding engineering students' perceptions of their curiosity, diligence, and perseverance and assessing its impact on their creativity

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ABSTRACT

Creativity has been among the most in-demand skills for many years. Previous studies have shown that being curious, hard-working, and persevering can significantly impact one's performance. This article is an exploratory study to understand engineering students' self-perception towards their own 1) Curiosity, 2) Diligence, and 3) Perseverance and how it affects their creativity. The research uses a well-curated study based on a survey, rubrics and statistics. The study found that curiosity has the highest potential to support creativity. However, it also has a rather intriguing relationship with diligence and perseverance. Awareness of the dynamic correlations between these three aspects can help educators design their pedagogical practices to support students to be more creative problem solvers.

Keywords: Creativity; engineering; curiosity; diligence; perseverance; education.

INTRODUCTION

The ability to produce creative solutions can support students in a world of fierce competition. However, being creative could be challenging as there is no one right way to be creative, and several factors such as students' interests, backgrounds, design tasks and an individual's personality might influence creativity. Several such studies are explored in the subsequent section, but this study's primary focus is to explore the relationship between creativity and student personality traits empirically.

Although a tricky construct, creativity can still be executed using divergent and convergent thinking, according to Guilford (1967). A straightforward definition of creativity was proposed by Sternberg and Lubart (1999): "Creativity is the ability to produce work that is both unique (i.e., original, surprising) and appropriate (i.e., useful, adaptable regarding task restrictions. Creativity is expressed as Fluency, Flexibility, Novelty, and Elaboration (Torrance 1970). Several recent studies point toward the necessity to be creative from a future employment perspective since it is one of the most in-demand skills (Pate 2020, Whiting 2020). Nevertheless, to develop creativity, one must first understand the factors influencing individuals' creativity.

A study found that creative thinking is prominently affected by Contextual factors and Individual factors. The individual factors include personality, intelligence, and emotions (Utriainen and Valtonen 2022).

Furthermore, Chen (2016) focused on how conscientiousness affects creativity in Chinese undergraduate students while studying the relationship between personality and everyday creativity. The association between subclinical autistic features, cognitive (performance-based), and personality-related (self-reported) creativity was also comprehensively explored (Jankowska, Omelańczuk et al. 2019). In another study, the personality of individuals was found to stimulate their creativity (Amabile, Collins et al. 2018).

In different phases of creating something new, an individual's personality can subtly contribute. For example, it was found that performance attitude and workplace behavior results from innovation behavior (Yesil and Sozbilir 2013). Personality traits and creative success have often and predictably been connected (Prabhu, Sutton et al. 2008). Therefore, several studies exist that link the different aspects of an individual with creativity, but it was also imperative to better understand personality traits and choose appropriate aspects to explore in depth this study.

Cattell (1946) listed down 22 personality traits, further studied by Fiske (1949), wherein he categorized the 22 personality traits into five broad categories based on self-rating, rating by peers and ratings by psychological staff members. Tupes and Christal (1961) reanalyzed the five personality traits by taking eight samples from high school education to first-year graduate-level students. Tupes and Christal (1961) corroborated the five broad personality traits

recommended by Fiske. Norman (1963) labeled the big five personality traits as extraversion, agreeableness, openness, conscientiousness, and neuroticism.

The Big Five personality traits—1) Openness to experience, 2) Conscientiousness (or Dependability), 3) Extraversion (Positive emotionality, level of activity, impulsivity, and risk-taking), 4) Agreeableness, and 5) Neuroticism (Emotional stability)—have been compared to perseverance (Goldberg 1992). In one study by Duckworth and Quinn (2009), the Short Grit Scale (Grit-S) and 12-item self-report measure of grit (Grit-O) measuring grit were strongly correlated with conscientiousness. McCrae and John (1992) understood that conscientiousness is being dutiful, self-disciplined and an achiever. Lakhal and Khechine (2017) further enrich a conscientious personality trait to assess the degree of organization, perseverance, and motivation in students' behaviour toward a goal. Conscientiousness is a bigger umbrella under which diligence and perseverance are categorized. The openness and persistence of students in problem-solving were among the characteristics explored as motivational predictors of learning processes. These two categories explain students' willingness to engage in problem-solving despite impediments and include components closely related to self-beliefs, goal orientations, personality, and interests (Scherera and Gustafsson 2015).

In engineering education, Mamaril (2016) studied self-efficacy, described as self-belief in their ability to perform a specific task. The authors found that it can predict students' performance in different tasks during a course. Furthermore, the effect of perseverant grit and self-belief on academic performance and academic success has been investigated and found to be positively linked (Usher et al. 2019, Valentine et al. 2004).

A growing body of literature exists to understand creativity and link it to personality traits. Nevertheless, these studies are scattered and do not converge to paint a clear picture depicting the relationship between the two. It is because personality traits have multiple aspects, and each aspect needs to be studied separately. The current study builds on the existing literature in an effort to contribute to this growing body of knowledge and explores students' personality traits and their impact on creativity in the engineering-specific context.

Therefore, in this study, we focus on diligence and perseverance among the five personality traits from the conscientiousness category and curiosity is opted from the openness to experience category. The other broad personality categories, such as neuroticism, agreeableness, and extraversion, are essential personality traits in the context of creativity. The effect of these personality traits will be studied in the future. Therefore, in this study, we attempt to understand if personality traits viz: Diligence, Curiosity, and Perseverance can support students to become more creative, and we ask the following research questions.

Research questions

1. To what extent does students' self-perception about curiosity, diligence, and perseverance varies and influences their ability to produce creative design solutions?

2. To what extent do students' curiosity, diligence, and perseverance, relate to each other and creativity?

THEORETICAL BACKGROUND

Creativity often demands out-of-the-box thinking to produce new solutions. One way of demonstrating creativity is by generating multiple ideas. Idea generation is the process of coming up with as many concepts as possible that are unique, useful, novel, and original. Idea promotion is the practice of involving oneself in the idea by looking for sponsors who have sway over the authorities (Agarwal 2014).

Academicians of the engineering fraternity usually focus on assessing the quality of the solution or ideas as a sign of creativity. The ideas are evaluated for key performance indicators such as uniqueness, novelty, quantity, or originality (Shah, Smith et al. 2003).

Researchers have explored several ways to generate ideas, for example, the use of different interventions, such as a course or ideas generation mechanisms, on creativity has been studied (Deo, Hölttä-Otto et al. 2020, Deo, Blej et al. 2021, Kirjavainen and Hölttä-Otto 2021). Lee et al. (2018) implemented design heuristics as an ideation tool and examined the applicability of Design Heuristics within individual and team concept generation contexts. Valentine et al. (2022) investigated the effect of using computers for idea generation on self-efficacy and performance. It was observed that using computers for idea generation did not negatively impact the students' self-efficacy.

Tiryaki, A. and Adigüzel (2021) investigated the effect of STEM-based robotic activities on the creativity and attitude of students. The study revealed that students enjoy STEM-based application problems rather than theoretical knowledge. Huang (2021) applied regression analysis and found that five types of informal workplace activities, such as learning through student interaction, colleagues' interaction, learning through media, stakeholder interaction and reflections, are positively related to teaching for creativity.

Abedini (2020) compared the creativity of students learning through the virtual classroom to those attending physical classes. The relationship between personality traits and creativity was stronger in virtual classrooms than in physical classes. Novikova et al. (2020) compared personality traits and creativity as predictors of success in foreign language acquisition (FLA). Creativity indicators have a more substantial but contradictory impact on the level of foreign language

proficiency compared to personality traits. Furthermore, Toh et al. (2016) studied personality traits, risk attitudes, and idea-generation abilities that impact the promotion or filtering of creative ideas in a team setting. Teams with higher conscientiousness, agreeableness, and tolerance for ambiguity have more ability to select novel concepts. Therefore, creativity has been extensively studied; however, student personality may influence their performance in creativity; hence, it is essential to understand the aspects of personality under investigation in this study.

Curiosity, i.e., the "desire to know," is perhaps the core of this intrinsic motivation (Schiefele, Krapp et al. 1992). Walsh et al. (2021) study has developed a new framework that defines and drives the innovation process with phases of curiosity, creativity, and clarity. Intrinsic motivation helps the individual think about the solution to an anticipated problem before the situation worsens and warrants a crisis. Curiosity is the crux of inherent motivation; thus, curious thinkers are better divergent thinkers (Alberti and Witryol 1994). Earlier studies show that newcomers in an organization score high as they have a good appetite to seek new knowledge and gain more information by socializing with colleagues (Reio Jr and Wiswell 2000). Curiosity is related to cognitive thinking, intellectual engagement, and the ability to think of out-of-the-box solutions (Mussel 2010). Plamondon (2000) observed that curious people welcome change and have more endurance to handle stress than less curious individuals. Further, Celik, Storme et al. (2016) argued that curiosity is not only limited to intrinsic motivation or knowledge seeking but also fosters innovative performance. These studies inspired us to explore the potential relationships between engineering students' personality traits and creativity.

John and Srivastava (1999) presented 44 item inventory that assists in measuring the Big Five Inventory personality of students. However, this study focuses on curiosity instead of all five traits John and Srivastava mentioned. Kashdan et al. (2018, 2020) devised a Five-Dimensional Curiosity Scale Revised (5DCR) that featured Joyous Exploration, Deprivation Sensitivity, Stress Tolerance, Social Curiosity, and Thrill Seeking. This is a validated tool and provided an opportunity to evaluate curiosity, and hence we deployed this tool.

Nowadays, perseverance has become one of the vital personality traits. Earlier Galton (1892) found that ability alone cannot bring success, wherein success is the outcome of zeal, relentless hard work, and an individual's ability. Howe (2001) asserted that perseverance is a necessary trait of intelligence in a person. Tenacity and perseverance are two non-cognitive traits that are critical for success (Shechtman, DeBarger et al. 2013). Perseverance and, openness, creativity is positively correlated, but individuals' perception greatly varies across different countries (Scherer and Gustafsson 2015). Duckworth (2007) mentioned the effort of

perseverance as grit, an essential requirement to achieve an individual's vision. Christensen and Knezek (2014) have successfully used the Grit scale to capture students' perception of their perseverance. It is a proven instrument that we opted to use for this study.

A Diligent personality trait indicates that an individual is actively working and not seeking to delegate responsibilities. In this way, adopting diligence is a wonderful liberator (Grow 2017). In several fields, the effect of diligence on academic and student performance has been studied. For example, Studies have shown that diligence supported students in enhancing their academic performance in tedious tasks (Galla, Plummer et al. 2014). Galla et al. (2020) conducted two field tests to investigate the effect of mindfulness on academic diligence and boredom. It was observed that students with high mindfulness were more prone to boredom but had high academic diligence. Fladljeiv et al. (2020) studied the effect of temporal behavior on diligence. It was observed that slow students are considered to be more diligent in getting more correct answers. Wu and Wu (2020) investigated differences between high- and low-creativity learners regarding cognition, personal motivation, and personality traits.

In industries, employee diligence is essential from the future employment point of view (Eisenberger, Fasolo et al. 1990). However, this aspect has not been studied much in engineering education, where students deal with complex, tedious problems of nebulous nature. Corgnet et al. (2016) found that overthinking can negatively affect creativity, and people with high diligence skills are hard to find. We adopted the diligence instrument Arthur (2000) used to assess diligence and further correlate it with creativity. It is a closed-end questionnaire that captures students' diligence using a simple Likert scale survey.

Several creativity assessment instruments are available, each focusing on a specific aspect of creativity or can be used in particular circumstances (Shah, Smith et al. 2003, Kershaw, Bhowmick et al. 2019). We used the Organisation for Economic Co-operation and Development's (OECD) creativity rubrics (1= Dormant to 5 = Outstanding) to assess creativity. These rubrics assess creativity aspects such as inquiring, imagining, doing, and reflecting and categorize them into products and processes (Vincent-Lancrin, González-Sancho et al. 2019).

METHODS AND DATA

In this study, out of 92, 69 first-year Mechanical Engineering students from an autonomous engineering college, MIT Academy of Engineering, India, opted to participate during the academic year 2021-22. Participants were briefed in class about the purpose of the study without revealing too much information about the study, and they were verbally informed that

Understanding engineering students' perceptions of their own curiosity, diligence, and perseverance and assessing its impact on their creativity

31

participation was voluntary and that this study was not directly related to the course nor would affect their grades in this course. Students were attending a mandatory Design thinking course. We followed the experimental procedure shown below in Fig. 1.
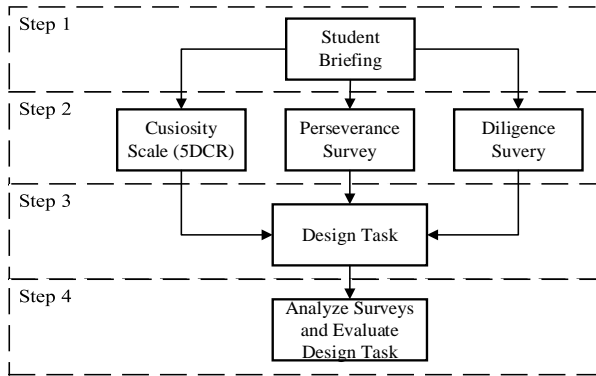

Fig. 1: Experimental approach

For this study, students had a design task to propose safe-to-use multipurpose cutting tool concepts for a prototyping lab. Each student did this task separately for 10 min. A few sample concepts are shown in Fig. 2. We trained two raters to use the OECD's creativity rubrics: a professor and a doctoral student. One rater evaluated all the concepts when they achieved an acceptable kappa of 0.76 after two rounds (Cohen 1960).
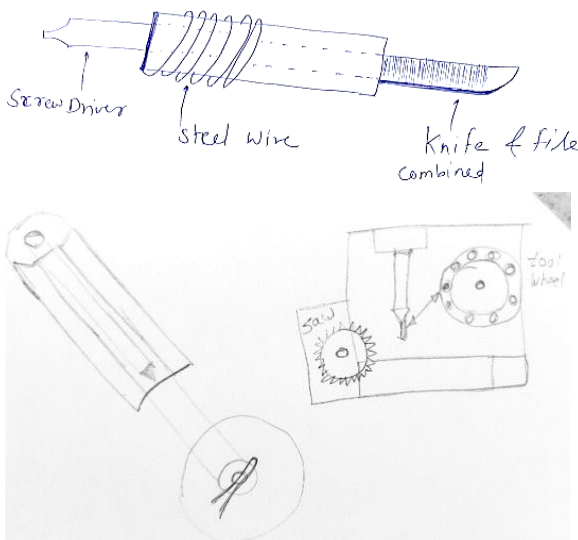

Fig. 2: Sample concepts produced by students

The participants completed three self-reported surveys reporting their perception of curiosity, perseverance, and diligence. First, participants completed the Five-Dimensional Curiosity Scale Revised (5DCR) by Kashdan et al. (2020). This was on a 7-item Likert scale from 1 = Does not describe me at all to 7 = Completely describes me (α = .82). To capture

perseverance toward a meaningful long-term goal, we deployed (Duckworth and Quinn 2009) short grit scale using five items Likert scale from 1= very much like me to 5 = not like me at all. (α = .75). Furthermore, to measure diligence, a revised diligence survey by Arthur (2000) was deployed with a 5-item Likert scale from 1= Never/Rarely 2= Occasionally 3= Sometimes 4= Usually 5= Almost Always (α = .72). For all the surveys used, their internal consistency of reliability was established, and Cronbach's alpha coefficients were above the acceptable level of 0.70 (Cronbach 1951, Tavakol and Dennick 2011). Students completed these surveys online in Moodle.

RESULTS

Exploratory Data Analysis

At first, descriptive statistics were studied (Table 1), and based on the mean score, students believed that they were quite curious (M= 4.47, SD= 1.40); however, the standard deviation is also the highest among the dataset, indicating a wide range in students' perception about curiosity. For diligence and perseverance, a similar mean score of (M= 2.89, SD= 0.818) and (M= 2.91, SD= 0.876) implies that the students had similar perceptions about these aspects and the responses had less deviation than curiosity.

Table 1. Descriptive Statistics.

Items	N	Min	Max	Mean	Std. Dev.
Curiosity	69	2.20	6.50	4.47	1.405
Diligence	69	1.20	4.50	2.89	.818
Perseverance	69	1.25	4.63	2.91	.876
Creativity	69	1.50	4.50	2.78	.867

Furthermore, the data were analyzed to identify any visible patterns and trends in student responses toward curiosity, diligence, and perseverance. Fig. 3 shows three pairs of student responses. The X axis is students, and the Y axis is survey-based scores. The graphs show that students reported a certain degree of opposite perception towards curiosity and diligence. It means curious students reported lower diligence. A similar pattern is visible in a graph with curiosity and perseverance, but results indicate that highly curious students do not show higher perseverance.

No such pattern is distinguishable from the diligence and perseverance graph, and results indicate students'

mixed perceptions towards diligence. We explored data further to gain better insights into how these aspects and creativity interacted.

Creativity Analysis

Here, we first measured the number of solutions produced by each student, as Shah et al. (2003) recommended. Students produced a total of 110 concepts (refer to Fig. 2). However, no statistical test was done on students' concepts since we did not have student groups to conduct comparative statistical analysis.

We calculated a creativity score for each concept using the OECD's creativity rubrics. It helped to identify concepts that can be classified as 'radically different', meaning highly creative concepts. In a previous article, Kershaw (2019) suggested that a concept scoring above 75% score was a radically different concept. In this study, we looked into creativity scores to identify radically different concepts and presented our findings in Fig 4. These concepts have creativity scores equal to and above 75%.
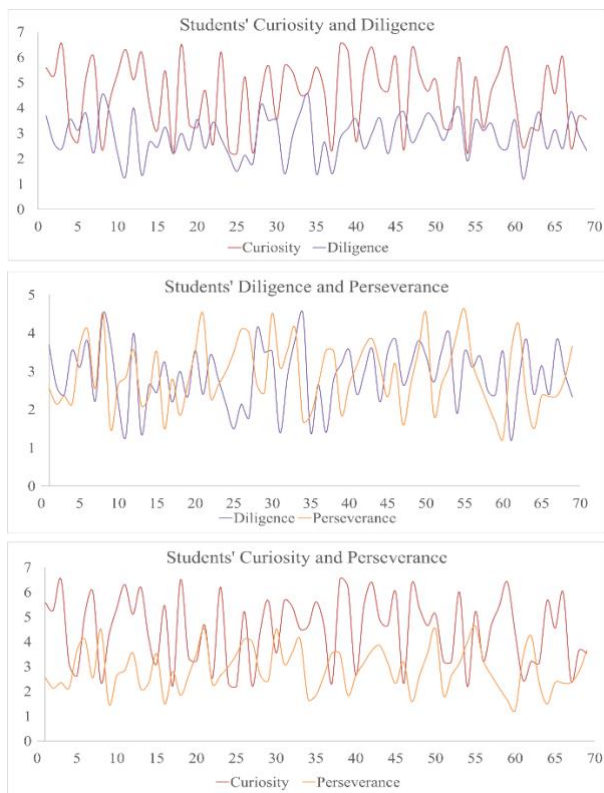
**Fig. 3:** Student perception of their curiosity, diligence and perseverance

This study had 11 such concepts. Fig. 4 shows a bar chart with a standard deviation. In most cases, high curiosity appears to be a consistent factor among students who produced radically different concepts. However, the two students reported similar curiosity and diligence (e.g., ID34 and ID60) and produced radically different

concepts. The remaining students who did not produce radically different concepts had a lower self-reported curiosity than the ones who produced radically different concepts, and all three characteristics followed a mixed pattern, unlike the one shown below in Fig. 4.
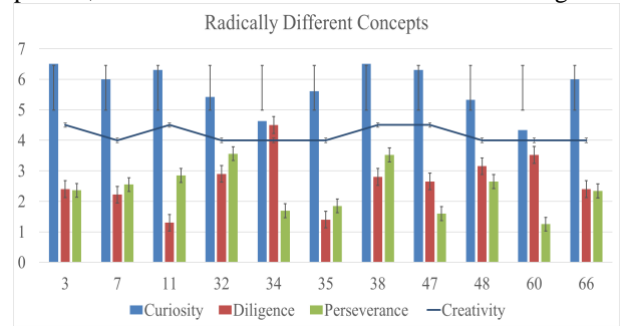
Fig. 4: Radically different concepts

Furthermore, Fig. 5 shows how each student's creativity compares to their perception of curiosity, diligence and perseverance. As shown in the graphs, to a certain extent, curiosity shows positive, and perseverance shows negative patterns with respect to creativity. Diligence does not show any noticeable trend with creativity. Additional analysis was performed in the next section to further affirm these initial visual observations.
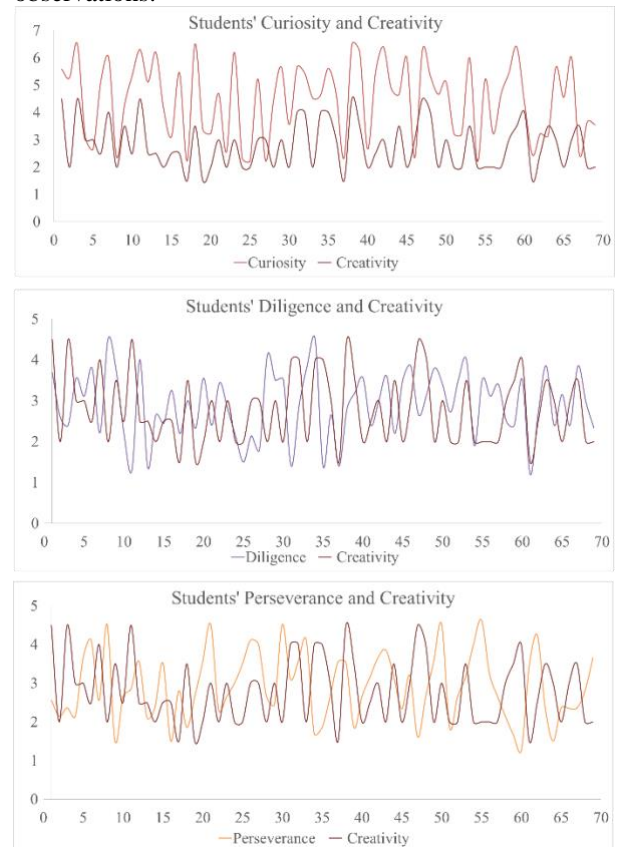
Fig. 5: Creativity mapping with curiosity, diligence and perseverance

Understanding engineering students' perceptions of their own curiosity, diligence, and perseverance and assessing its impact on their creativity

33

Correlation Analysis

We checked data normality and computed Pearson's correlation coefficient in SPSS to understand if there is any relationship between curiosity, perseverance, diligence, and creativity. Results are tabulated in Table 2. The results show a statistically significant negative correlation between curiosity and perseverance, $r(67) = -.294$, $p = .014$, as well as creativity and perseverance, $r(67) = -.324$, $p = .007$.

However, there is a very significant positive correlation between the other two variables, creativity and curiosity, $r(67) = 0.568$, $p = .001$. Diligence showed either a negative or positive correlation with the remaining variables; however, it was not significant ($p > 0.05$).

Table 2. Correlation between curiosity, perseverance, diligence, and creativity.

Sr. No.	Curiosity	Diligence	Perseverance	Creativity
Curiosity	1	-0.038	-0.294*	0.568**
	-	.755	0.014	0.001
Diligence	-0.038	1	0.007	-0.025
	.755	-	0.956	0.839
Perseverance	-0.294*	0.007	1	-0.324**
	0.014	0.956	-	0.007
Creativity	0.568**	-0.025	-0.324**	1
	0.001	0.839	0.007	-

* Correlation is statistically significant at the 0.05 level (2-tailed)
** Correlation is statistically significant at the 0.01 level (2-tailed)

DISCUSSION AND CONCLUSIONS

In this study, we aimed to understand a potential relation between students' self-perception towards curiosity, diligence, and perseverance and their influence on creativity. We answer two research questions during this study.

Research Question 1

Exploratory Data Analysis (EDA) and creativity analysis helped to answer the first research question. The results indicate that students' self-perception about their curiosity, diligence and perseverance greatly vary. Especially curiosity and perseverance show a negative relationship (refer to Fig. 3). The quantitative analysis also confirmed this observation. On the other hand, diligence does not show any apparent connection with the other variables.

Interestingly, when we looked into the creativity scores of all concepts, the students with high curiosity produced radically different concepts. A complementing finding was visible in a positive correlation between curiosity and creativity. This finding was similar to the one by Amabile et al. (2018), in which student personalities stimulate their creativity. Perhaps in this study, it was the curiosity of the student which stimulated their creativity. Additionally, Shah and Smith (2003) found that a higher quantity of solutions may lead to higher creativity, but we did not see that pattern implying a sheer number of concepts is not always the primary determinant. However, another parameter to consider could be the lack of domain knowledge. Previous studies have found domain knowledge as an important variable in creative problem-solving (Benjamins, Fensel et al. 1996, Mayer 2006). The participants did not have any engineering knowledge that could have affected the quantity or creativity scores of solutions produced.

Previous studies have found that intrinsic motivation and perseverance are correlated, and perseverance leads to higher creativity (McGraw and Fiala 1982, Eisenberger and Shanock 2003). Although we saw less perseverance than curiosity, it resulted in more creative solutions, contrary to the above finding. Mrazek, Ihm et al. (2018) trained students in perseverance. Perhaps repeating the creativity exercise after training students to enhance perseverance would be interesting.

In both methods we used, the lack of evidence on the relation between diligence and creativity is in line with the previous study that people with high diligence are hard to find (Corgnet, Espín et al. 2016). Perhaps the given design task was not suitable to demonstrate diligence which could be one of the reasons for the lower correlation between diligence and creativity. Repeating the study with different design tasks might help shed light on this aspect in the future.

Research Question 2

The second research question explored how the dynamics between curiosity, diligence, perseverance and creativity work. The results indicate that the students have quite different perceptions of their curiosity, perseverance, and diligence.

We also found that curiosity and creativity had the strongest positive correlation, confirming the previous findings (Schutte and Malouff 2020). Evidence from the study (Table 2) strongly suggests that students with higher curiosity produce solutions with higher creativity. At the same time, students who believed to have lower perseverance had higher creativity which is opposite to the previous findings (McGraw and Fiala 1982, Eisenberger and Shanock 2003). Diligence and perseverance did not indicate any specific relationship; diligence seemed to have the weakest link with creativity.

Since perseverance requires consistent efforts, curiosity leads to better divergent thinking (Alberti and

Witryol 1994). Perhaps, if students are expected to solve a single complex problem requiring long-term efforts, more self-belief in perseverance might be suitable, but if students are expected to produce radically different solutions, students with higher curiosity might perform better. We did notice a positive effect of higher curiosity on student creativity.

FUTURE WORK

The study had a couple of limitation that needs to be addressed in the future, such as the limited sample size. Students reported that all three questionnaires were too long (70 questions). More optimized versions must be developed and validated in the future. In the future, it would be interesting to swap the personality aspects, for example, curiosity with motivation or diligence with confidence to study their impact on creativity. Also, this study was conducted in one country and in one engineering institute, so it would be interesting to repeat the study in a different country to see if and how culture or other contexts affect the results.

CONCLUSION

Overall results indicate intricate dynamics between these aspects. The aspects under study either correlate positively or negatively or, in some cases, do not correlate. Although the results of this study showed promising aspects, they also imply the need to conduct more research to understand students' lower or higher perceptions of their curiosity, diligence, and perseverance. Leveraging the understanding of such dynamics while designing courses, assignments and pedagogical practices can support teachers in designing a better learning ecosystem promoting students' creativity.

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APPENDIX 1: CURIOSITY SURVEY (FIVE-DIMENSIONAL CURIOSITY SCALE REVISED (5DCR) (KASHDAN, T. B., ET AL., (2018))

Response Scale: 1 – Does not describe me at all; 2 – Barely describes me; 3 – Somewhat describes me; 4 – Neutral; 5 – Generally describes me; 6 – Mostly describes me; 7 – Completely describes me

Social Curiosity

I ask a lot of questions to figure out what interests other people.

When talking to someone who is excited, I am curious to find out why.

When talking to someone, I try to discover interesting details about them.

I like finding out why people behave the way they do.

When other people are having a conversation, I like to find out what it's about.

When around other people, I like listening to their conversations.

When people quarrel, I like to know what's going on.

I seek out information about the private lives of people in my life

Joyous Exploration

I view challenging situations as an opportunity to grow and learn.

I seek out situations where it is likely that I will have to think in depth about something.

I enjoy learning about subjects that are unfamiliar to me.

I find it fascinating to learn new information.

Thrill Seeking

Risk-taking is exciting to me.

When I have free time, I want to do things that are a little scary.

Creating an adventure as I go is much more appealing than a planned adventure.

I prefer friends who are excitingly unpredictable.

Deprivation Sensitivity

Thinking about solutions to difficult conceptual problems can keep me awake at night.

I can spend hours on a single problem because I just can't rest without knowing the answer.

I feel frustrated if I can't figure out the solution to a problem, so I work even harder to solve it.

I work relentlessly at problems that I feel must be solved.

Stress Tolerance

The smallest doubt can stop me from seeking out new experiences.

I cannot handle the stress that comes from entering uncertain situations.

I find it hard to explore new places when I lack confidence in my abilities.

It is difficult to concentrate when there is a possibility that I will be taken by surprise.

APPENDIX 2: DILIGENCE SURVEY
(ARTHUR, C. G. (2000))

Response Scale: 1 = Never/Rarely; 2 = Occasionally; 3 = Sometimes; 4 = Usually; 5 = Almost Always

I work very hard to get good grades.

I strive to do all my assignments to the best of my ability.

I try to do outstanding work in all my classes.

I like my assignments to look neat and tidy.

I want to do the best I can in school.

I like to take up academic challenges.

I try to turn in my homework assignments on time.

I like to have quiet moments to plan how to succeed in school.

I make sure my assignments are done correctly.

I stop periodically while reading and review the information.

I try to see the relationships between what I'm studying and what I already know.

When I am studying a topic, I try to make all the ideas fit logically.

I proofread assignments before turning them in.

I take care to complete all my assignments.

When preparing for an exam, I create questions that I think might be included and study them.

If I return from school later than normal, I would offer an explanation to my parents/guardians.

I do not turn in my assignments until I'm sure it is correct.

I set high standards for myself in school.

Even when I am tired, I try to complete my assignments.

I am able to do my assignments without prompting.

I make constructive use of my leisure time.

I find it difficult to complete my assignments.

I have difficulty settling down on my studies at home.

I find it difficult to sustain attention to my schoolwork.

I find myself not prepared for tests as I would like.

I get upset over the amount of schoolwork I have to do.

I like to obey my teachers promptly.

I obey my parents/guardians promptly.

Personally, I like to take a little time out to meditate and pray.

I do my homework before I spend time with friends.

My friends see me as very organized in school.

I listen to everything the teacher says in class.

I do my assignments as soon as I get them.

APPENDIX 3: PERSEVERANCE SURVEY
(DUCKWORTH, A. L., ET AL. (2007))

Response Scale: 1 = Not at all like me; 2 = Partially like me; 3 = Neutral; 4 = Mostly like me; 5 = Very much like me

Consistency of Interest

I often set a goal but later choose to pursue a different one.

I have been obsessed with a certain idea or project for a short time but later lost interest.

I have difficulty maintaining my focus on projects that take more than a few months to complete.

New ideas and projects sometimes distract me from previous ones.

My interests change from year to year.

I become interested in new pursuits every few months.

Perseverance of Effort

I finish whatever I begin.

Setbacks don't discourage me.

I am diligent.

I am a hard worker.

I have achieved a goal that took years of work.

I have overcome setbacks to conquer an important challenge.

**APPENDIX 4: CREATIVITY RUBRICS
(VINCENT-LANCRIN, S., ET AL., (2019))**

Sr. No.	Level 5: Outstanding	Level 4: Excellent	Level 3: Emergent	Level 2: Basic	Level 1: Dormant
Product	The student work: • is highly imaginative, showing many instances of personal features and risk-taking (formulation, technique, composition or content) • fully meets the requirements of the task • goes beyond the knowledge and rules expected to be mastered by the student in more than one aspect.	The student work: • is imaginative, showing some examples of personal features (formulation, technique, composition or content) • meets the requirements of the task • goes beyond the knowledge and rules expected to be mastered by the student in one aspect.	The student work: • is personal in some of its features (formulation, technique, composition or content) • meets some but possibly not all the requirements of the task • is in line with the knowledge and rules expected to be mastered by the student.	The student work: • meets the requirement of the task but • reproduces existing examples, with a little personal perspective on formulation, content, technique or composition.	The student did not meet any aspect of the task and did not produce any results.
Process	The work process: • shows a willingness to examine carefully a variety of ideas as well the ability to make meaningful connections with other ideas or domains. • generated several unusual or radical ideas and pushed some to their limits before making the final choices. • shows a clear awareness of the areas of personal novelty and risk that were pursued, and of why the final choices were made.	The work process: • shows a willingness to brainstorm. ideas and examines carefully the chosen idea. • generated one unusual or radical. idea and pushed it to its limit before making the final choices. • shows a clear awareness of the areas of personal novelty or risk that were pursued.	The work process: • shows a willingness to think or act beyond one's first idea, but connections made between ideas or domains lack consistency or remain superficial. • fails to explore selected ideas with depth. • shows little awareness of the areas of personal novelty or risk that were pursued.	The work process: • is limited to the exploration of imitative patterns or to the examples presented by the teacher or expected to be familiar.	The student did not meet any aspect of the task and did not produce any results.