# Topic: Goal Question Metrics

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**Date of Submission**
15th January, 2025

# 1. Introduction

GQM, the initialism for "goal, question, metric", is an established goal-oriented approach to software metrics to improve and measure software quality.

GQM defines a measurement on three dimensions. They are-

**Conceptual Level (Goal):** A goal is defined for an object, for a variety of reasons, with respect to various models of quality, from various points of view and relative to a particular environment.

**Operational level (Question)**: A set of questions is used to define models of the object of study and then focuses on that object to characterize the assessment or achievement of a specific goal.

**Quantitative level (Metric):** A set of metrics, based on the models, is associated with every question in order to answer it in a measurable way.
We'll have to first fixate our goal, then develop a question set to collect data from related people or stakeholders. The questions must have appropriate metrics to measure the result later. We have to create a questionnaire to collect data from people defined in the scope. The last part will include metrics analysis with result derivation to

## 1.1 Project Specification

**Project Overview**

The project aims to investigate the influence of AI tools on creative thinking among students who use these tools regularly. By employing the Goal-Question-Metric (GQM) approach, this study evaluates whether AI tools enhance or hinder students' ability to think creatively and innovate. The primary focus is on understanding how AI tools are integrated into academic, professional, and personal contexts and their impact on creativity.

**Motivation**

With the rapid advancement of AI tools like ChatGPT and DALL-E, their role in shaping creativity has become a topic of interest. While these tools provide convenience and efficiency, there is growing concern about their potential to limit independent thinking and originality. This project seeks to address these concerns by assessing the experiences of students who rely on AI tools. The insights gained will not only contribute to understanding the relationship between AI and creativity but also help in designing better tools that support innovation and originality.

# Scope

This project is focused on the following aspects:

**Target Audience:** Students who actively and regularly use AI tools for various tasks.

**Data Collection:** A structured questionnaire designed to gather responses on AI usage, creative processes, and innovation.

**Metrics and Analysis:** Using quantitative metrics to analyze the impact of AI tools on creativity, originality, and independent thinking.

**Limitations:**
- Small Dataset
- Field Of Study

# 2. Goal Definition

This part provides a concise overview of the GQM assignment, highlighting its goal, purpose, perspective, and environment.

## 2.1 Goal

***"To evaluate the impact of AI tools on creative thinking among students who use AI regularly, focusing on how these tools influence their ability to think creatively and innovate."***

## 2.2 Purpose
To assess the role of AI tools in shaping creative thinking in order to understand whether they enhance or limit innovation and originality among students.

## 2.3 Perspective
Examine the influence of AI tools on creative thinking from the viewpoint of students who regularly use these tools, to assess their impact on fostering or hindering creativity.

## 2.4 Environment
The environment consists of students who actively and regularly use AI tools for their academic, professional, and personal projects, with varying levels of reliance on these tools for creative tasks.

# 3. Questions Set & Metrics

**1. How often do you use AI tools (e.g., ChatGPT, DALL-E, etc.) for academic or creative tasks?**

**Metrics:**

- Frequency of usage categorized into daily, weekly, occasional, rare, or never.
- Task type distribution (academic vs. creative).

**2. What is your field of study?**

**Metrics:**

- Field-wise distribution of AI tool usage.
- Correlation between field of study and frequency of AI tool usage.
- Comparison of creative task outcomes across fields of study.

**3. To what extent do you feel AI tools enhance your ability to generate creative ideas?**

**Metrics**

- Number of unique ideas generated per hour (manual vs AI)
- Percentage of AI-suggested ideas adopted compared to manually generated ideas.
- Variety of concepts generated in different categories (e.g., design, functionality) by AI vs human.

**4.Have AI tools ever helped you overcome creative blocks?**

**Metrics:**

- Percentage of creative blocks overcome with AI assistance versus without.
- Average time to resolve creative blocks with AI  versus without

**5. Do you feel AI tools provide innovative ideas, or do they rely on existing patterns or knowledge?**

**Metrics:**

- Percentage of AI-generated ideas innovative versus  based on existing patterns.
- Measure how often AI ideas repeat known concepts versus introducing entirely new concepts.

**6. Do you think relying on AI tools makes it harder for you to think independently?**

**Metrics:**

- Compare the percentage of ideas  come up with own Vs with AI help
- Average time needs to think with AI  versus without.

**7. Have you ever felt that AI tools limited your ability to innovate because the suggestions were too generic or predictable?**

**Metrics:**

- Percentage of Respondents Reporting Innovation Limitation
- Frequency of Generic or Predictable Suggestions

**8. How confident are you in solving creative problems without AI tools after having used them frequently?**

**Metrics:**

- Measure of confidence in solving problems independently before and after using AI tools frequently.
- Number of problems solved without AI assistance vs. with AI help.

**9. Do you feel your personal creative process has changed since you started using AI tools?**

**Metrics:**

-  Measure the percentage of creative process that has changed since using AI vs. stayed the same
-  Comparison of average time taken to generate ideas before and after using AI tools.

**10. Do you believe AI tools can be trained or customized to support your unique creative thinking style?**

**Metrics:**

- Percentage of Respondents Agreeing with Customization Potential
- Track the increase in creative output or idea quality after AI customization.

## 4. Questionnaire Preparation and Data Collection

As we have decided our Goal and Corresponding GQM, we'll now proceed to collect real world data in order to justify our statement. To do so we have done as follows:

First we made a curated list of Survey Questions that covers almost all aspects of judging our goal's criteria. Secondly, we prepared a google form, as it's the most convenient way to conduct our survey among our target Audience. Now the crucial part was to select the target audience. According to the goal, there were only concerned about those students who use AI regularly.

A sample question format is given-

Question: To what extent do you feel AI tools enhance your ability to generate creative ideas?

- ○ Significantly enhance
- ○ Somewhat enhance
- ○ No impact
- ○ Somewhat limit
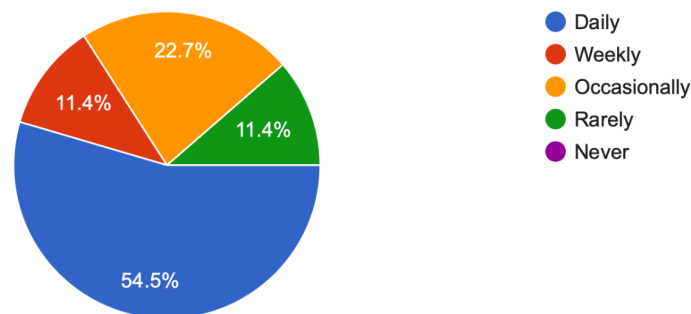- ○ Significantly limit

After gathering enough data, started the analysis of which details are depicted in the following

## 5. Survey Questionnaire and Results

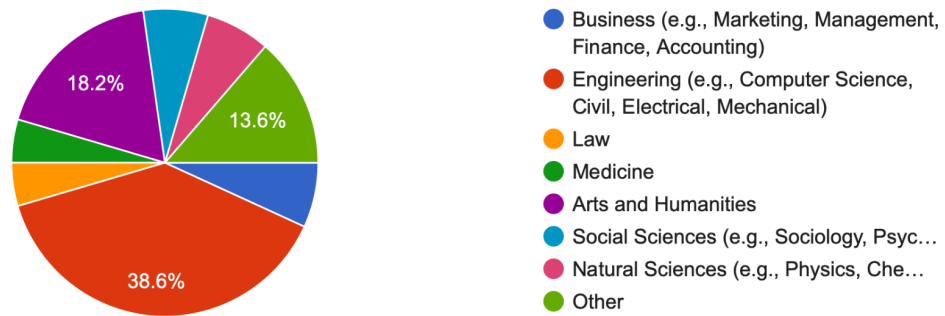Google form link: https://forms.gle/9FruzAPRMqLFbC5q7

Q1. How often do you use AI tools (e.g. ChatGPT, DALL-E, Copilot etc.) for academic or creative tasks?
44 responses

## Q2. What is your field of study?
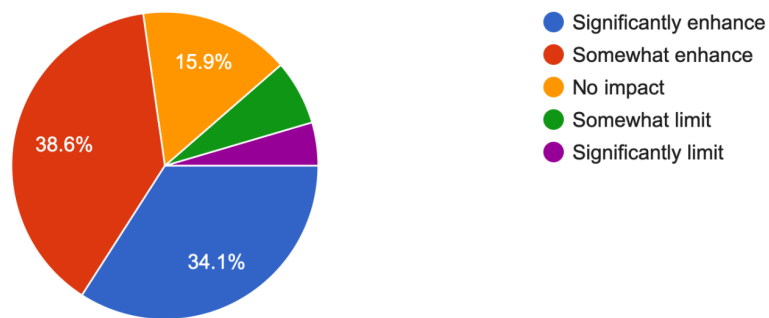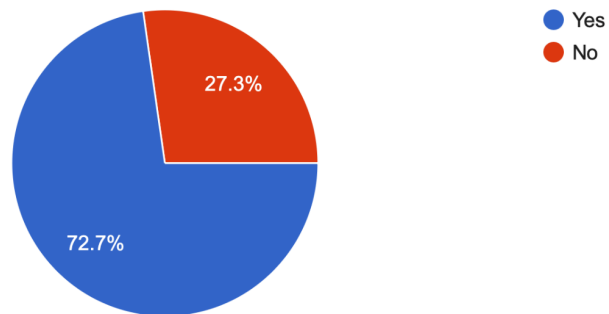
44 responses



- ● Business (e.g., Marketing, Management, Finance, Accounting)
- ● Engineering (e.g., Computer Science, Civil, Electrical, Mechanical)
- ● Law
- ● Medicine
- ● Arts and Humanities
- ● Social Sciences (e.g., Sociology, Psyc…
- ● Natural Sciences (e.g., Physics, Che…
- ● Other

## Q3. To what extent do you feel AI tools enhance your ability to generate creative ideas?

44 responses



- ● Significantly enhance
- ● Somewhat enhance
- ● No impact
- ● Somewhat limit
- ● Significantly limit

## Q4. Have AI tools ever helped you overcome creative blocks?
44 responses

Legend:
- Yes
- No

27.3%

72.7%

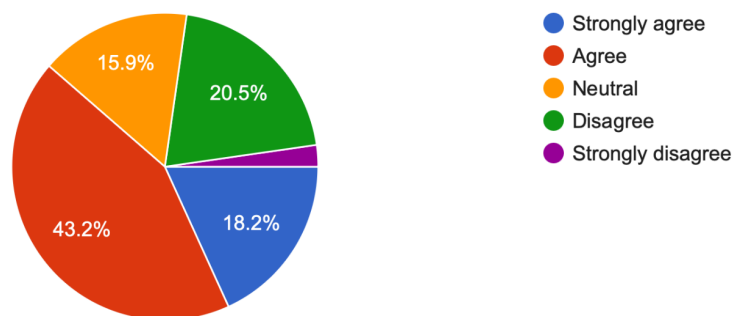## Q5. Do you feel AI tools provide innovative ideas, or do they rely on existing patterns or knowledge?
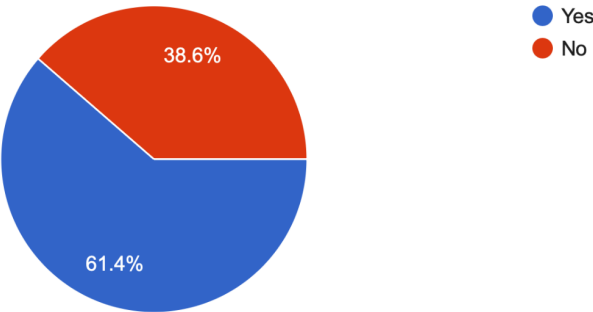44 responses

Legend:
- Mostly innovative ideas
- Blend of innovative and existing patterns
- Mostly rely on existing patterns

31.8%

45.5%

22.7%
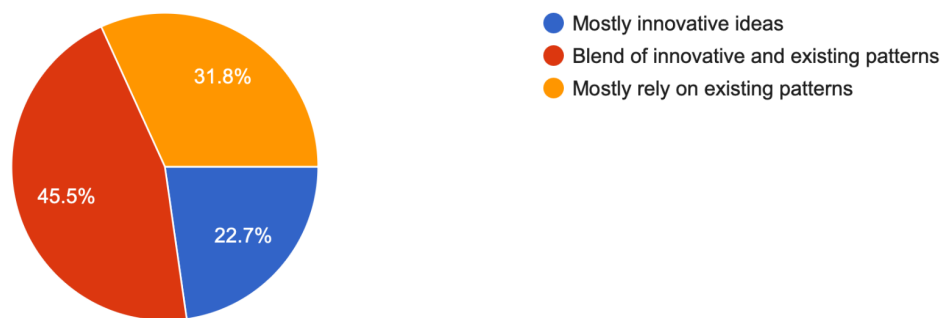
## Q6. Do you think relying on AI tools makes it harder for you to think independently?
44 responses

Legend:
- Strongly agree
- Agree
- Neutral
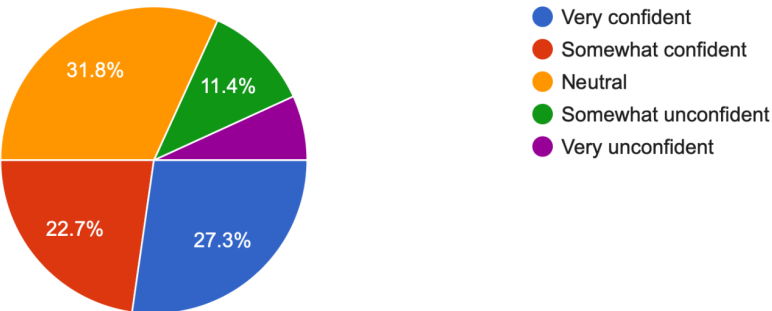- Disagree
- Strongly disagree

15.9%

20.5%

43.2%

18.2%

Q7. Have you ever felt that AI tools limited your ability to innovate because the suggestions were too generic or predictable?
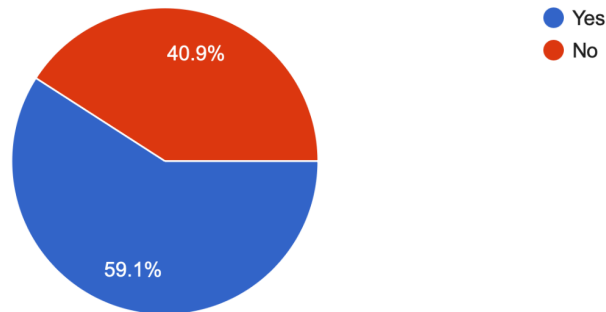
44 responses



- Yes
- No

38.6%

61.4%

Q8. How confident are you in solving creative problems without AI tools after having used them frequently?

44 responses



- Very confident
- Somewhat confident
- Neutral
- Somewhat unconfident
- Very unconfident

31.8%

11.4%

22.7%

27.3%

Q9. Do you feel your personal creative process has changed since you started using AI tools?

44 responses



- Yes
- No

40.9%

59.1%

Q10. Do you believe AI tools can be trained or customized to support your unique creative thinking style?

44 responses



- Yes
- No
- Not sure

13.6%

31.8%

54.5%
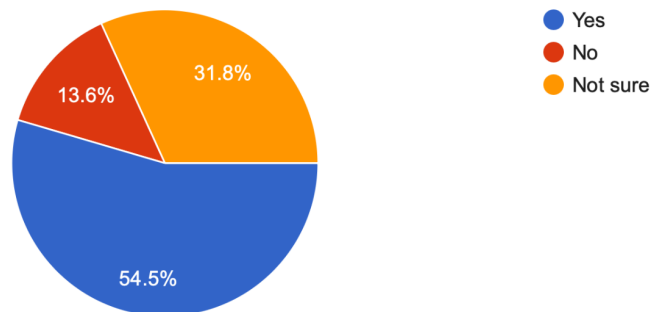
# 6. Metrics Analysis

Based on the response we got from our survey, we performed some statistical analysis which are delineated below.

## 3. To what extent do you feel AI tools enhance your ability to generate creative ideas?

This Survey asked the respondents if they feel AI tools enhance their ability to generate creative ideas. The following options were provided: Significantly enhance, Somewhat enhance, No impact, Somewhat limit, Significantly limit. The responses were Significantly enhance (15), Somewhat enhance (17), No impact (7), Somewhat limit (3), Significantly limit (2). Two

categories were made: "enhance" concerning Significantly enhance and Somewhat enhance options and "limit" concerning Somewhat limit and Significantly limit in ability to generate creative ideas. No impact responses were split into both categories (4 for enhance and 3 for limit).

Observations for AI tools enhance ability to generate creative ideas = 15 + 17 + 4 = 36 and for AI tools limit ability to generate creative ideas = 3 + 2 + 3 = 8.

**Null hypothesis H₀:** AI tools do not enhance your ability to generate creative ideas.

For both categories, the expected value is 44/2=22. A chi square test was done in excel spreadsheet and the p-value has been calculated using the GraphPad tool.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | **Ability to Generate Creative Idea** | **Frequency** | **Category** | **Observed** | **Expected** |
| 3 | Significantly enhance | 15 | Enhance | 36 | 22 |
| 4 | Somewhat enhance | 17 | Limit | 8 | 22 |
| 5 | No impact | 7 | | | |
| 6 | Somewhat limit | 3 | | P-value | <0.0001 |
| 7 | Significantly limit | 2 | | | |

The p value is less than 0.0001 which is less than the significance level 0.05. So that observed values do not support expected values. Thus our Null hypothesis is rejected.

Based on the result of the survey, it can infer that AI tools enhance the ability to generate creative ideas..

## 4. Have AI tools ever helped you overcome creative blocks?

Based on the responses to the question, the data revealed the following:

32 respondents believed that AI tools have helped them overcome creative blocks.
12 respondents did not believe that AI tools have helped them overcome creative blocks.
In total, 32 respondents felt that AI tools helped overcome creative blocks, while 12 respondents did not.

**Null Hypothesis H₀:** " AI tools do not help in overcoming creative blocks."

To test this hypothesis, we calculated the expected values for both categories (those who believe AI tools help overcome creative blocks and those who do not), assuming no significant difference. We performed a chi-square test and the results were displayed in an Excel spreadsheet.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | AI helps to overcome creative block | | | Observed | Expected | |
| 3 | Yes | | | 32 | 22 | |
| 4 | No | | | 12 | 22 | |
| 5 | | | | p-value | 0.0026 | |

The p-value obtained from the chi-square test was 0.0026, which is less than the significance level of 0.05. This indicates that the observed values significantly differ from the expected values, leading us to reject the null hypothesis.

Based on the survey results, we can infer that there is a statistically significant relationship between the use of AI tools and the ability to overcome creative blocks. This suggests that, according to the majority of respondents, AI tools help in overcoming creative blocks.

**5. Do you feel AI tools provide innovative ideas, or do they rely on existing patterns or knowledge?**

Based on the responses to the question, "Do you feel AI tools provide original ideas, or do they rely on existing patterns or knowledge?", the data revealed the following:

10 respondents felt that AI tools provide mostly innovative ideas. 20 respondents felt that AI tools provide a blend of innovative ideas and existing patterns. 14 respondents felt that AI tools rely mostly on existing patterns.
In total, 30 respondents believed that AI tools provide either innovative ideas or a mix of innovative and existing patterns, while 14 respondents thought AI tools rely mostly on existing patterns.

 **Null Hypothesis ($H_0$) :** "AI tools not only rely on existing patterns but also give innovative patterns."

To test this hypothesis, we calculated the expected values for both categories (those who believe AI tools provide innovative ideas or a mix and those who believe AI tools rely mostly on existing patterns), assuming no significant difference. We performed a chi-square test and the results were displayed in an Excel spreadsheet.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | Innovative ideas VS Existing patterns | | | Frequency | Observed | Expected |
| 3 | Mostly Innovative | | | 10 | 10 | 14 |
| 4 | Blend of innovative and existing patterns | | | 20 | 20 | 15 |
| 5 | Existing patterns | | | 14 | 14 | 15 |
| 6 | | | | | p-value | 0.2374 |

As the p-value (0.2374) is greater than 0.05, the null hypothesis is accepted. It states that AI is a blend of innovative and existing patterns.

### 6. Do you think relying on AI tools makes it harder for you to think independently?

Based on the responses to Question 6 from the survey, the data revealed the following:
8 respondents strongly agreed that AI tools make independent thinking harder. 19 respondents agreed that AI tools make independent thinking harder.7 respondents were neutral and expressed no opinion on the matter.9 respondents disagreed, stating that AI tools do not make independent thinking harder.1 respondents strongly disagreed with this notion.
In total, 31 respondents believed that AI tools make independent thinking harder while 13 respondents disagreed.

**Null Hypothesis (H₀) :** "Relying on AI tools does not make independent thinking harder."

To test this hypothesis, we calculated the expected values for both categories (those who believe AI tools make independent thinking harder and those who do not), which is 42/2 = 21. A chi-square test was performed using GraphPad (graphpad.com), and the results were displayed in an Excel spreadsheet.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | AI Tools: Making Independent Thinking Harder | Frequency | Category | Observed | Expected |
| 3 | Strongly Agree | 8 | Agree | 31 | 22 |
| 4 | Agree | 19 | Disagree | 13 | 22 |
| 5 | Neutral | 7 | | | |
| 6 | Disagree | 9 | | P-value | 0.0067 |
| 7 | Strongly Disagree | 1 | | | |

As the p-value is .0067 which is less than 0.05. So, the null hypothesis is rejected. According to the survey it can be concluded that relying on AI tools makes thinking independently harder.

### 7. Have you ever felt that AI tools limited your ability to innovate because the suggestions were too generic or predictable?

Based on the responses to the question, the data revealed the following:

27 respondents believed that AI tools limit their ability to innovate by providing generic or predictable suggestions.
17 respondents disagreed, stating that AI tools do not limit their ability to innovate.
In total, 27 respondents thought that AI tools limit their innovation capability, while 17 respondents did not.

**Our Null Hypothesis ($H_0$) :** "AI tools haven't limited ability to innovate because the suggestions were too generic or predictable"

To test this hypothesis, we calculated the expected values for both categories (those who believe AI tools limit their innovation and those who do not), which is 44/2 = 22. A chi-square test was performed using GraphPad (graphpad.com), and the results were displayed in an Excel spreadsheet.

| | Limits ability for innovation | | Observed | Expected |
|---|---|---|---|---|
| 1 | | | | |
| 2 | Limits ability for innovation | | Observed | Expected |
| 3 | Yes | | 27 | 22 |
| 4 | No | | 17 | 22 |
| 5 | | | p-value | 0.1317 |

The p-value obtained from the chi-square test was 0.1317, which is greater than the significance level of 0.05. This indicates that we can not reject the null hypothesis.

Based on the survey results, we can conclude that there is not a significant relationship between the use of AI tools and the perceived limitation on innovation capability. This suggests that, according to the majority of respondents, AI tools haven't limited the ability to innovate.

**8. How confident are you in solving creative problems without AI tools after having used them frequently?**

Based on the responses to the question, "How confident are you in solving creative problems without AI tools after having used them frequently?", the data revealed the following:

12 respondents expressed high confidence in solving creative problems independently without AI tools after frequent use. 10 respondents felt somewhat confident in solving creative problems independently without AI tools. 14 respondents felt neutral about their confidence in solving creative problems without AI tools. 5 respondents expressed low confidence in solving creative problems independently without AI tools.
3 respondents expressed very low confidence in solving creative problems without AI tools.

In total, 29 respondents felt confident to varying degrees in solving creative problems independently, while 15 respondents expressed low confidence in doing so without AI tools.

**Null hypothesis (H₀)** : "Frequent use of AI tools does not impact confidence in solving creative problems independently."

To test this hypothesis, we calculated the expected values for both categories (those who are confident in solving problems independently and those who are not), which is 44/2 = 22. A chi-square test was performed using GraphPad (graphpad.com), and the results were displayed in an Excel spreadsheet.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | Confidence in Creative Problem-Solving Without AI | Frequency | Category | Observed | Expected |
| 3 | Very Confident | 12 | Confident | 29 | 22 |
| 4 | Somewhat Confident | 10 | Unconfident | 15 | 22 |
| 5 | Neutral | 14 | | | |
| 6 | Somewhat Unconfident | 5 | | P-value | 0.0348 |
| 7 | Very Unconfident | 3 | | | |
| 8 | | | | | |

The p-value obtained from the chi-square test was 0.0348, which is less than the significance level of 0.05. Since the p-value is less than 0.05, we reject the null hypothesis.

Based on the survey results, we can infer that there is a relationship between AI tool usage and confidence in solving creative problems independently. This suggests that, for the majority of respondents, frequent use of AI tools impact their confidence in solving creative problems without assistance.

## 9. Do you feel your personal creative process has changed since you started using AI tools?

This Survey asked the respondents  if they feel their personal creative process has changed for using AI tools. The following options were provided: Yes, No. The responses were  Yes(26), No(18).

So, Observations for AI tools has changed personal creative process = 26 and for AI tools hasn't changed personal creative process = 18

**Null hypothesis (H₀)** : " Using AI tools does not  change the personal creative process."

So for both categories our expected value is 44/2=22. A chi square test was done in excel spreadsheet. The p-value has been calculated using the GraphPad tool.

| | Limits ability for innovation | Observed | Expected |
|---|---|---|---|
| 1 | | | |
| 2 | **Limits ability for innovation** | **Observed** | **Expected** |
| 3 | Yes | 26 | 22 |
| 4 | No | 18 | 22 |
| 5 | | **p-value** | 0.2278 |

As p-value 0.2278 which is greater than 0.05. So, the null hypothesis is accepted.
According to the survey result ,It can be concluded that AI tools don't change personal creative processes.

## 10. Do you believe AI tools can be trained or customized to support your unique creative thinking style?

Based on the responses to the question, the data revealed the following:
24 respondents believed that AI tools can be trained or customized to support their unique creative thinking style. 14 respondents were unsure whether AI tools can be trained or customized to support their unique creative thinking style. 6 respondents did not believe that AI tools can be trained to support their unique creative thinking style.
In total, 31 respondents believed that AI tools can be trained or customized for their creative thinking style, while 13 respondents did not.

**Null Hypothesis ($H_0$) :** " AI tools cannot be trained or customized to support unique creative thinking styles."

To test this hypothesis, we calculated the expected values for both categories (those who believe AI tools can be trained and those who do not), assuming no significant difference. We performed a chi-square test and the results were displayed in an Excel spreadsheet.

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | Training AI to support unique creative style | | | Frequency | | Category | Observed | Expected |
| 3 | Yes | | | 24 | | Yes | 31 | 22 |
| 4 | Not sure | | | 14 | | No | 13 | 22 |
| 5 | No | | | 6 | | | p-value | 0.0067 |

The p-value obtained from the chi-square test was 0.0067, which is less than the significance level of 0.05. This indicates that the observed values significantly differ from the expected values, leading us to reject the null hypothesis.
Based on the survey results, we can infer that there is a statistically significant relationship between AI tool usage and the belief that AI tools can be trained or customized to support unique creative thinking styles. This suggests that, according to the majority of respondents, AI tools can be trained or customized to support unique creative thinking styles.

## 6. Result of Analysis:

In the following table we have gathered all the outcomes of our survey questionnaire. From that table we can have the birds eye view of our collected data and their corresponding verdicts.

| SL no. | Questions | Result |
|---|---|---|
| Q3. | To what extent do you feel AI tools enhance your ability to generate creative ideas? | Yes, AI tools enhance the ability to generate creative ideas. |
| Q4. | Have AI tools ever helped you overcome creative blocks? | Yes, AI tools help in overcoming creative blocks. |
| Q5. | Do you feel AI tools provide innovative ideas, or do they rely on existing patterns or knowledge? | Blend of innovative and existing ideas. |
| Q6. | Do you think relying on AI tools makes it harder for you to think independently? | Yes, reliance on AI tools makes independent thinking harder. |
| Q7. | Q7. Have you ever felt that AI tools limited your ability to innovate because the suggestions were too generic or predictable? | No, AI tools haven't limited ability to innovate because the suggestions were too generic or predictable. |
| Q8. | How confident are you in solving creative problems without AI tools after having used them frequently? | Yes, AI tools impact confidence in solving creative problems . |
| Q9. | Do you feel your personal creative process has changed since you started using AI tools? | No, Using AI tools does not change the personal creative process. |
| Q10. | Do you believe AI tools can be trained or customized to support your unique creative thinking style? | Yes, AI tools can be trained or customized to support unique creative thinking styles. |

# 7. Conclusion

The survey results provide valuable insights into the impact of AI tools on the creative thinking of students who use these tools regularly. Overall, the findings suggest that AI tools have a significant positive influence on students' ability to think creatively and innovate, but there are nuances to consider:

1. **Enhanced Creativity:** A majority of respondents agree that AI tools enhance their ability to generate creative ideas and help overcome creative blocks. This indicates that AI tools act as a catalyst for fostering innovation and ideation.

2. **Innovative Potential:** While AI tools provide a blend of innovative and existing ideas, their ability to generate novel solutions is appreciated without being perceived as limiting or overly predictable.

3. **Challenges with Independence:** Despite their benefits, reliance on AI tools appears to hinder independent thinking for some users. This highlights the need for mindful integration of AI into creative processes to ensure it supplements rather than supplants individual creativity.

4. **Confidence in Creative Problem-Solving**: Frequent use of AI tools influences confidence in solving creative problems without their assistance, suggesting a dependency factor that may need to be addressed through balanced usage.

5. **Adaptability to Unique Styles:** Respondents believe that AI tools can be trained and customized to support unique creative thinking styles, underlining the importance of personalization



AI Usage Impact on Student Creativity Factors