STA304 Written Report

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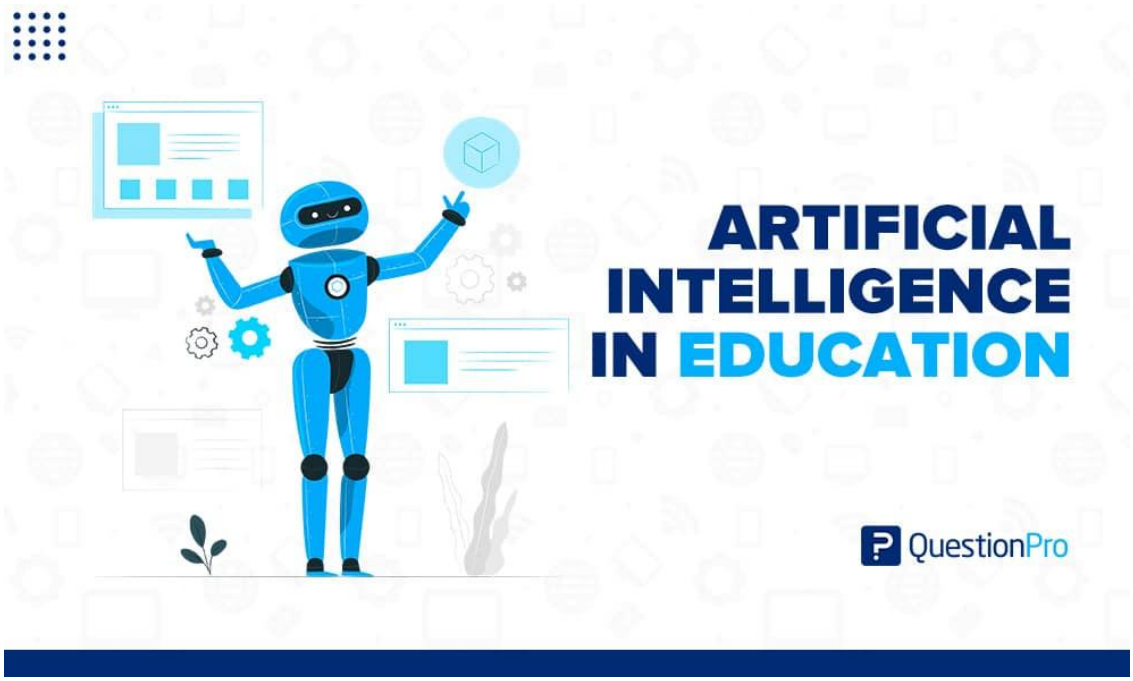

Topic: Analyzing the impact and outcomes of integration of Artificial Intelligence in student's learning

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Introduction

As AI tools have revolutionized the educational process, understanding the intricate ways in which they affect learning is of utmost importance. From self-learning and proof checking all the way to cheating and plagiarism, knowing the variety of ways these new tools are utilized is necessary to maintain the integrity of all academia. Our part in helping answer this crucial question is to ask this smaller question:

"Does there exist a positive relationship between the usage of AI tools and the perception of said tools within the STA304 student populace?"

Description of Variables

Variable	**Description**
Familiarity with AI	Whether the participant has previously used AI tools for educational purposes
Educational Benefits	Participant's perception regarding the benefits of AI tools for learning
AI Tools Efficiency	Participant's perception of how well AI tools improve understanding of content
Accuracy of AI Tools	Participant's perception of how accurate AI tools are.
Utilization methods	How participants utilize AI tools for educational purposes
Usage of AI Tools	Percentage of participants time using AI tools for studying
AI Recommendation	Whether the participant would recommend AI tools to others for education purposes

Results

Computations

For this study, we assumed the student population has a size of N = 200, representing the students enrolled in STA304 Fall 2023. As 30 students responded to the questionnaire, the sample size n = 30. Since variables such as proportion $\hat{p}$ are unknown before sampling, $\hat{p} = 0.5$. A "bound of error" is therefore needed in order to determine how far estimates will be away from the true proportion, and is calculated as such:

$$B = 2\sqrt{\frac{\hat{p}\hat{q}}{n-1}\left(1-\frac{n}{N}\right)} = 2\sqrt{\frac{0.5 \cdot 0.5}{30-1}\left(1-\frac{30}{200}\right)} \approx 0.17$$

Discussion

While chi-square and regression testing gives us valuable insights such as pattern association and predictability of relationships between variables, it would be fitting to first examine correlations between certain variables to better understand how our data is related

Variables	Result	Meaning
AI Tools Efficiency & Accuracy of AI Tools	Moderately positive correlation	As efficiency increases, perception of accuracy moderately does too
Usage of AI Tools & AI Recommendation	Negative correlation	As usage increases, the chances of being recommended decreases, and vice versa

Table 1: Results of correlation testing

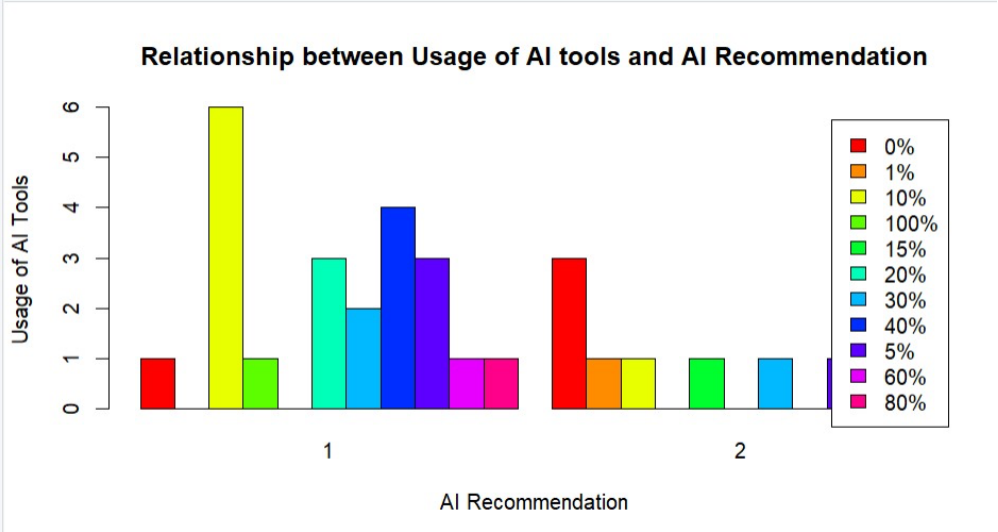
The table above reveals the results of some basic testing done to see the correlation between AI tools' efficiency, accuracy, usage, and recommendations. By analyzing these variables, we can see how they interact with each other on a small scale. There exists a moderately positive correlation between AI Tools Efficiency and Accuracy of AI Tools, suggesting that as the perception of the efficiency of AI tools increases, the perception of their accuracy increases too. On the other hand, there is a negative correlation between the Usage of AI Tools and AI Recommendation, implying that as the usage of AI tools increases, the recommendations of these AI tools decreases.

Terms	**P-value**	**Results**
Usage of AI Tools & AI Recommendation	0.1499	No significant association
AI Tools Efficiency & Usage of AI Tools	0.279	No significant association
Accuracy of AI Tools & Usage of AI Tools	0.002289	Significant association

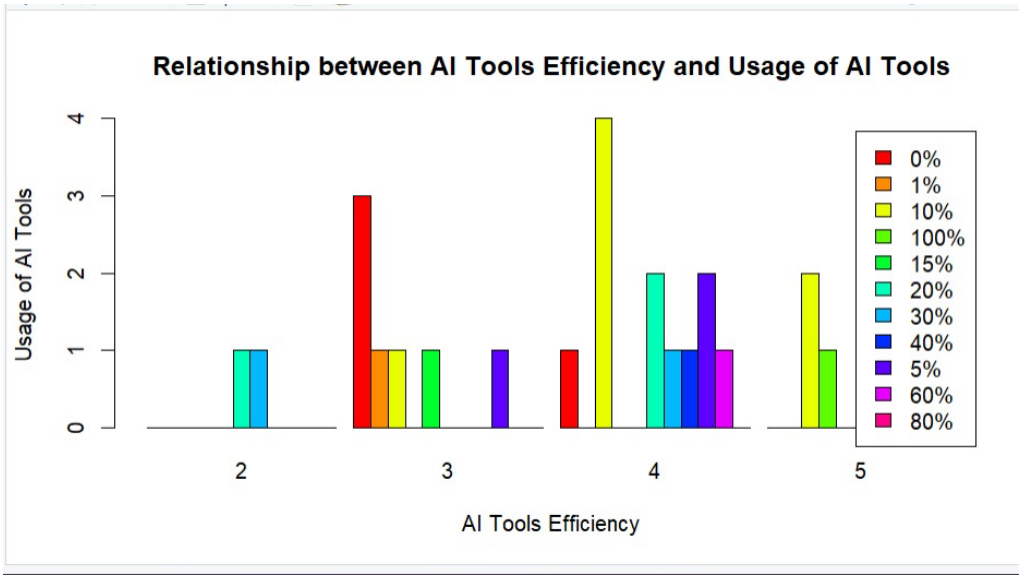
Table 2: Results of chi-square testing

The table above consists of the results for the chi-square test performed for 4 variables in pairs, showing whether one variable is associated with another. For the first chi-square test between **Usage of AI tools** and **AI Recommendation**, the p-value is less than 0.05. This indicates that there's no significant association between the percentage of time participants spend using AI tools for studying and the likelihood that they would

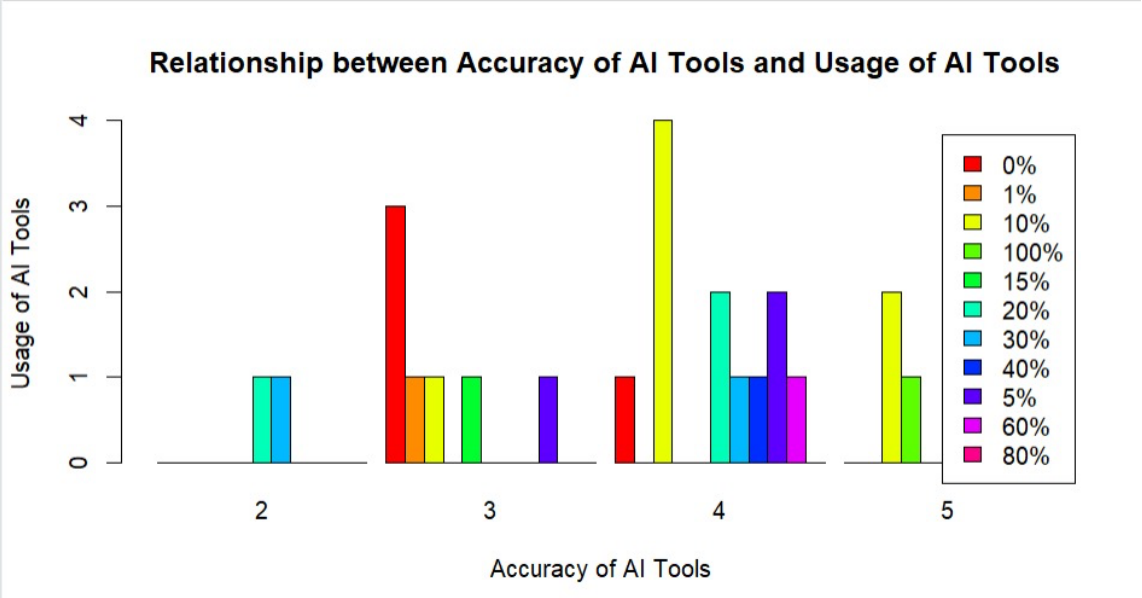
recommend these tools to others.



Regarding the second chi-square test between the variables **AI Tools Efficiency** and **Usage of AI Tools**, the p-value is less than 0.05. This indicates that there is no significant association between the efficiency of AI tools and the percentage of time students spend using AI tools.



Regarding the third chi-square test between the two variables, **Accuracy of AI Tools** and **Usage of AI Tools**, the p-value is greater than 0.05. This indicates that there is a significant positive association between the accuracy of AI tools and the percentage of time students spend using AI tools.



1. **Identifying Patterns:** After performing statistical tests, the study indicates a significant relationship between students' usage of AI tools for educational purposes and their perception of these tools.
   We also see, that those who haven't used AI tools previously tend to be more inclined to recommend their use in education compared to those who have prior experience using them

2. **Influence of AI Utilization:** Our findings reveal a great insight about AI utilization among students. The logistic regression depicted a negative coefficient for familiarity with AI tools, indicating that there is a possible decrease in likelihood of recommending AI tools with increased usage. It shows a complex connection with AI tools and advocates their use in education.

3. **Statistical Associations:** Conducting chi-square tests showed interesting associations. A significant relationship was observed between perceived accuracy of AI tools and their usage methods for learning. It might be helpful to highlight how perception of accuracy might shape the utilization of AI tools in education.

4. **Implications for Future Research:** Despite limitations, our findings offer a valuable insight into the integration of AI in education. Further research and studies could address these limitations by diversifying the sample, and also by employing more rigorous survey distribution, in order to gather more comprehensive data.

Conclusion & Limitations

With the growing emergence of Artificial Intelligence in all facets of life, its impact on education is one of great importance. Studies like ours aim to provide valuable insight into how students are adapting to these tools and what these patterns imply for the future of learning, for better or worse.

While our analysis concludes that we fail to reject the null hypothesis, variability is always a factor between samples, reality, and an individuals' own opinions. For this reason, certain limitations must be acknowledged as part of our project. Our method of survey sampling introduces limitations such as selection bias and sampling bias: Since our sample consisted purely of students in their 3rd and 4th year, as well as those taking an advanced statistics course, they likely have the same uses and needs for using AI tools for learning. Since the survey was partially distributed through Piazza, many students who did not read the announcements or didn't frequent Piazza were automatically excluded from potentially answering our survey, introducing selection bias, as they were less likely to complete the survey. Additionally, the small sample size of only 30 introduced problems such as not being able to conclude confident generalizations and having lower accuracy and wider confidence intervals.

Additionally, the use of AI tools for learning purposes is a rather controversial topic. With many institutions prohibiting the use of these tools for assignments, as well as some populists highlighting how they can negatively impact critical thinking, there is a strong inclination to not answer in the affirmative when asked about using these tools despite the guaranteed anonymity.

Appendix

R-Code

R-code for statistical information

```
mean_improving = mean(data$AI_Improves_Concepts)
mean_improving
[1] 3.933333
median_improving = median(data$AI_Improves_Concepts)
median_improving
[1] 4
std_dev_improving = sd(data$AI_Improves_Concepts)
std_dev_improving
[1] 0.9071871
confidence_interval_improving = t.test(data$AI_Improves_Concepts)$conf.int
confidence_interval_improving
[1] 3.594584 4.272083
attr(,"conf.level")
[1] 0.95
mean_accuracy = mean(data$AI_Accuracy)
mean_accuracy
[1] 3.266667
median_accuracy = median(data$AI_Accuracy)
median_accuracy
[1] 3
std_dev_accuracy = sd(data$AI_Accuracy)
std_dev_accuracy
[1] 0.7849153
confidence_interval_accuracy = t.test(data$AI_Accuracy)$conf.int
confidence_interval_accuracy
[1] 2.973574 3.559759
attr(,"conf.level")
[1] 0.95
# Remove the "%" sign from $AI_Usage_Percent and convert to numeric
data$AI_Usage_Percent <- as.numeric(gsub("%", "", data$AI_Usage_Percent))
mean_percentage = mean(data$AI_Usage_Percent)
```

```
mean_percentage
[1] 21.86667
median_percentage = median(data$AI_Usage_Percent)
median_percentage
[1] 10
> std_dev_percentage = sd(data$AI_Usage_Percent)
std_dev_percentage
[1] 24.19851
confidence_interval_percentage = t.test(data$AI_Usage_Percent)$conf.int
confidence_interval_percentage
[1] 12.83080 30.90254
attr(,"conf.level")
[1] 0.95
```

R-code for chi-square Statistical Independence test

```
library(tidyverse)
library(nnet)
# assign data to variables
usage_percent = data$AI_Usage_Percent
recommendation = data$AI_Recommendation
improve_concepts = data$AI_Improves_Concepts
accuracy = data$AI_Accuracy

contingency_table = table(usage_percent, recommendation)
chi_square_result = chisq.test(contingency_table)
chi_square_result

      Pearson's Chi-squared test

data:  contingency_table
X-squared = 14.537, df = 10, p-value = 0.1499

contingency_table2 = table(usage_percent, improve_concepts)
chi_square_result2 = chisq.test(contingency_table2)
chi_square_result2

      Pearson's Chi-squared test
```

```
data:  contingency_table2
X-squared = 34.045, df = 30, p-value = 0.279

contingency_table3 = table(accuracy, usage_percent)
chi_square_result3 = chisq.test(contingency_table3)
chi_square_result3

     Pearson's Chi-squared test

data:  contingency_table3
X-squared = 56.663, df = 30, p-value = 0.002289
```

R-code for Logistics Regression test

```
logistic_model = multinom(AI_Recommendation ~ AI_Familiarity, data=data)
# weights:  3 (2 variable)
initial  value 20.794415
final  value 15.875119
converged

summary(logistic_model)
Call:
multinom(formula = AI_Recommendation ~ AI_Familiarity, data = data)

Coefficients:
                  Values Std. Err.
(Intercept)     0.4055049 0.9128746
AI_Familiarity -1.7918457 1.0408395

Residual Deviance: 31.75024
AIC: 35.75024
```

R-code for chi-square test bar plots

```
rm(list=ls())
library(tidyverse)
library(nnet)
setwd("C:/Users/shiva/OneDrive/Desktop/3rd year/sta304")
my_data = read.csv("Dataset.csv")
percent_times = my_data$AI_Usage_Percent
recommendation = my_data$AI_Recommendation
contingency_table = table(percent_times ,recommendation)
chi_square_result = chisq.test (contingency_table , simulate.p.value =
TRUE)
barplot(as.matrix(contingency_table),
+         beside = TRUE,
+         col = rainbow(nrow(contingency_table)),
+         legend = rownames(contingency_table),
+         xlab = "AI Recommendation",
+         ylab = "Usage of AI Tools",
+         main = "Relationship between AI Recommendation and AI Usage
Percent")

improve_concepts = my_data$AI_Improves_Concepts
accuracy = my_data$AI_Accuracy
contingency_table2 = table(percent_times,improve_concepts)
barplot(as.matrix(contingency_table2),
+         beside = TRUE,
+         col = rainbow(nrow(contingency_table)),
+         legend = rownames(contingency_table),
+         xlab = "AI Tools Efficiency",
+         ylab = "Usage of AI Tools",
+         main = "Relationship between AI Tools Efficiency and Usage of AI
Tools")

contingency_table3 = table(accuracy , percent_times)
barplot(as.matrix(contingency_table2),
+         beside = TRUE,
+         col = rainbow(nrow(contingency_table)),
+         legend = rownames(contingency_table),
+         xlab = "Accuracy of AI Tools ",
+         ylab = "Usage of AI Tools",
```

```
 +         main = "Relationship between Accuracy of AI Tools and Usage of
 AI Tools")
```

R-code for correlation testing

```
correlation_result_1 <- cor.test(data$AI_Improves_Concepts, data$AI_Accuracy)
correlation_result_1
Pearson's product-moment correlation

data:  data$AI_Improves_Concepts and data$AI_Accuracy
t = 2.7539, df = 28, p-value = 0.01023
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.1216251 0.7047223
sample estimates:
      cor
0.4616652
correlation_result2 <- cor.test(data$AI_Recommendation, data$AI_Usage)
correlation_result2
Pearson's product-moment correlation

data:  data$AI_Recommendation and data$AI_Usage
t = -2.0481, df = 28, p-value = 0.05003
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.6382365569 -0.0008020834
sample estimates:
      cor
-0.360967
```

Questionnaire

1. Have you previously used AI tools for educational purposes?
    a. Yes
    b. No
2. How do you perceive the potential benefits of AI in your learning? Please select all that apply.
    a. Improve personalized learning
    b. Enhance student engagement
    c. Better assessment
    d. Time saving
    e. Other (specify)
3. How well do you think AI improves the understanding of course content?
    a. 1 (Not at all)
    b. 2
    c. 3
    d. 4
    e. 5 (A lot)
4. How accurate do you think AI is?
    a. 1 (Not at all)
    b. 2
    c. 3
    d. 4
    e. 5 (A lot)
5. How do you utilize AI tools in education? (eg. As a tutor)
6. What percent of your study time is spent using AI tools?
7. Would you recommend the use of AI tools in education to your peers?
    a. Yes
    b. No
    c. Maybe