1. Introduction

This project aims to explore the use of Virtual Reality (VR) in education, examining its impact on student learning outcomes and applicability across different academic fields. By analyzing data on students' VR usage hours, perceived effectiveness, and learning outcomes, I developed an interactive Shiny app to better understand the multidimensional impact of VR in education.

2. Dataset Overview and Preparation

The dataset used in this project is titled *Impact of Virtual Reality in Education*, containing survey responses from over 1,000 students and 22 variables. Key variables include:

- **Weekly VR Usage Hours**: Indicates the amount of time (in hours) students spend using VR for learning each week.
- **Improvement in Learning Outcomes**: A binary variable indicating whether students experienced improved learning outcomes after using VR.
- **Perceived Effectiveness of VR**: Rated on a scale from 1 to 5, representing levels from "Not effective" to "Very effective."
- **Stress Level**: Measures the change in stress levels (High, Medium, Low) while using VR.
- **Field of Study**: Includes fields such as Science, Arts, Medicine, Engineering, Business, Education, and Law, representing the students' academic disciplines.

To ensure data accuracy and consistency, I conducted the following preprocessing steps:

- **Handling Missing Values**: Removed or filled missing values to avoid biases in the analysis.
- **Standardization of Variables**: Standardized variables such as VR usage hours to ensure compatibility with visualizations.
- **Categorization**: Convert some variables (e.g., perceived effectiveness) to factor types to enhance interactive visualization.

3. Shiny Interface Design and Interaction

The Shiny app is designed to be user-friendly and interactive, featuring the following functionalities:

- **Dropdown menus and sliders**: Users can select different visualization types and adjust the range of weekly VR usage hours to observe changes in learning outcomes and perceived effectiveness.
- **Graphical interaction**: The app includes bar charts, scatter plots, and density plots to showcase the relationship between VR usage and learning outcomes, VR usage across different fields, and students' perceived effectiveness of VR.

4. Visualizations and Relationships

1. **VR Usage vs. Improvement in Learning Outcomes**

    - **Chart Type**: Bar chart. This chart shows the proportion of students reporting improved learning outcomes across different VR usage ranges. Whether the usage is between 0-4 hours or 4-8 hours per week, the proportions of improvement and non-improvement are generally around **50-50**, indicating that simply increasing VR usage time does not significantly enhance learning outcomes.
2. **Field of Study vs. Perceived Effectiveness of VR**
    - **Chart Type**: Grouped bar chart. This chart displays the distribution of perceived VR effectiveness across different fields of study, rated from 1 to 5. Although there are minor differences across fields, no significant preference emerges, suggesting that VR has broad applicability across academic disciplines.
3. **VR Usage Hours vs. Field of Study**
    - **Chart Type**: Scatter plot and density plot.
        - **Scatter plot**: Shows the distribution of weekly VR usage hours among students in various fields. The distribution is relatively even across fields, indicating no clear preference for VR usage duration in specific fields.
        - **Density plot**: Illustrates the density distribution of perceived VR effectiveness across different fields, further supporting the notion that perceived effectiveness is similar across disciplines.

5. Findings and Analysis

During the analysis, I found:

- **Effect of VR Usage Hours**: Whether the weekly VR usage is short (0-4 hours) or moderate (4-8 hours), the proportion of students reporting improved learning outcomes remains nearly the same, suggesting that simply increasing VR usage time does not necessarily enhance learning outcomes.
- **Perceived Effectiveness Across Fields**: Students' perceived effectiveness of VR is relatively consistent across fields of study, indicating that VR's educational applicability may not be significantly influenced by specific academic disciplines.

6. Reactive Structure of the Application

The Shiny app utilizes `reactive()` and `observeEvent()` functions to enable dynamic updates. When users adjust the slider or select different views, the charts automatically refresh, providing real-time feedback and data visualization. The modular design of the code ensures readability, maintainability, and efficient user interaction.

7. Conclusion and Reflection

The findings suggest that VR's educational impact is relatively similar across different usage durations and fields of study, implying its broad potential in education. Future research should consider other variables (e.g., types of learning content, learning environments) to further explore VR's impact on learning outcomes. Additionally, expanding the dataset and enhancing interactive features could improve the depth of analysis and user experience of the Shiny app.