



# Hemostasis Challenge: A Serious Game for Building Confidence and Competence in Laparoscopic Bleeding Control



## Introduction

- **Clinical Gap:** Intraoperative bleeding is a frequent, high-risk complication in laparoscopic surgery that requires both technical precision and psychological resilience.
- **Training Limitations:** Convntional physical simulators are costly and lack the scenario diversity needed to replicate unpredictable, real-world bleeding events.
- **The Innovation:** This study evaluates "Hemostasis Challenge," a mobile serious game using AI-detected authentic surgical clips to improve trainee confidence and objective technical performance.

## Method

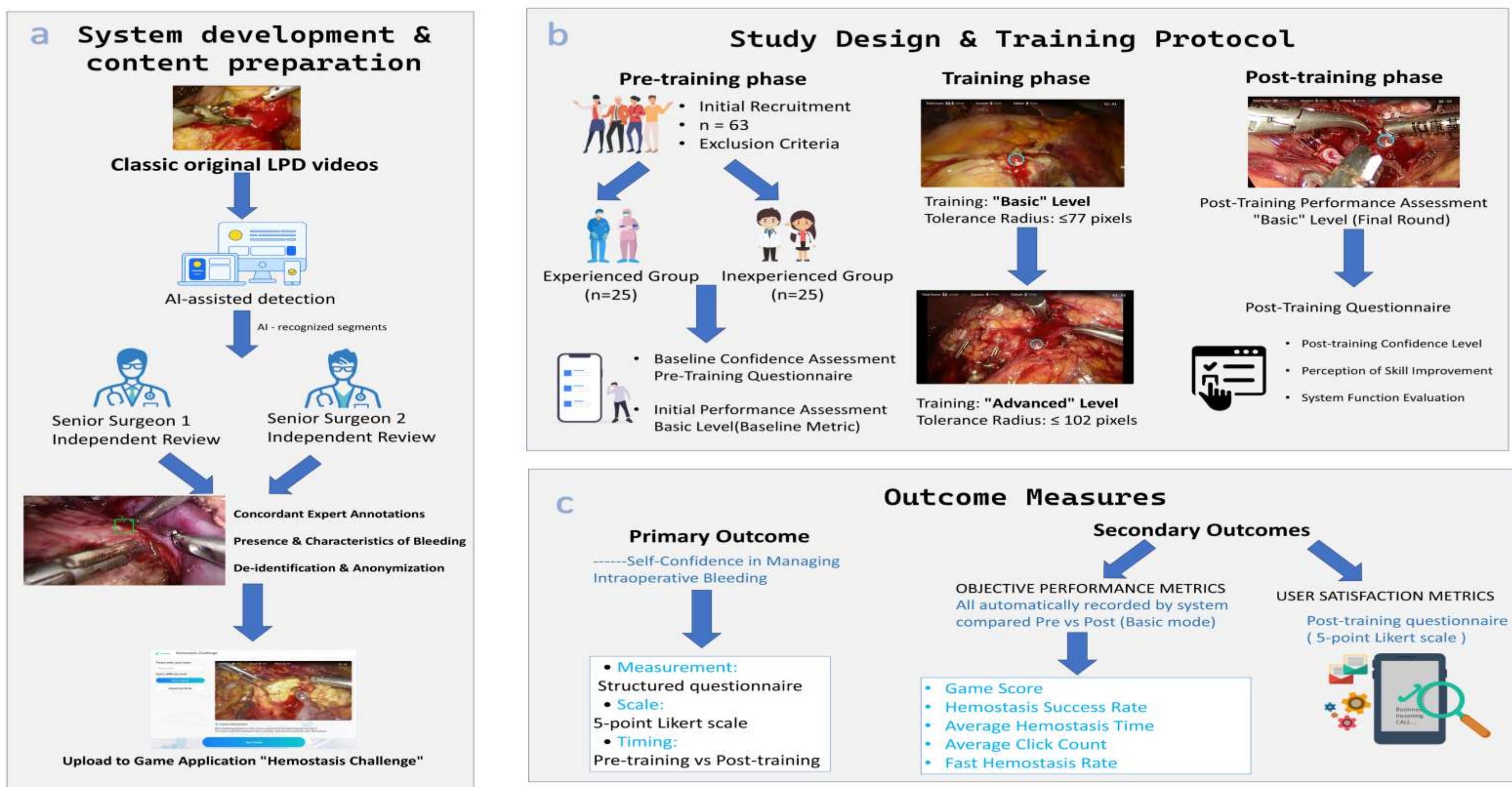


Figure 1. Schematic of the Gamified Training System Study Design.

The process encompassed three phases:

- (a) System development and content preparation workflow, from original LPD surgical videos through AI-assisted detection and expert validation to final game implementation;
- (b) Study design showing participant flow through pre-training assessment, progressive training (Basic → Advanced levels with specified tolerance radius), and post- training evaluation;
- (c) Outcome measures framework displaying primary outcome (self-confidence change) and secondary outcomes (objective performance metrics and user satisfaction).

## Result

TABLE 1. Participant Baseline Characteristics and Pre-training Game Performance.

| Metric                        | Inexperienced Group | Experienced Group | p-value |
|-------------------------------|---------------------|-------------------|---------|
| Pre-training Confidence (1-5) | 1.72 ± 0.74         | 3.08 ± 0.91       | < 0.001 |
| Game Score                    | 57.66 ± 8.69        | 54.12 ± 14.32     | 0.415   |
| Hemostasis Success Rate (%)   | 92.20 ± 10.32       | 92.20 ± 10.32     | 0.327   |
| Average Hemostasis Time (s)   | 2.49 ± 1.15         | 2.34 ± 0.76       | 0.712   |
| Average Click Count           | 2.44 ± 0.64         | 2.73 ± 0.90       | 0.184   |
| Fast Hemostasis Rate* (%)     | 51.09               | 56.58             | 0.444   |

## Primary Outcome:

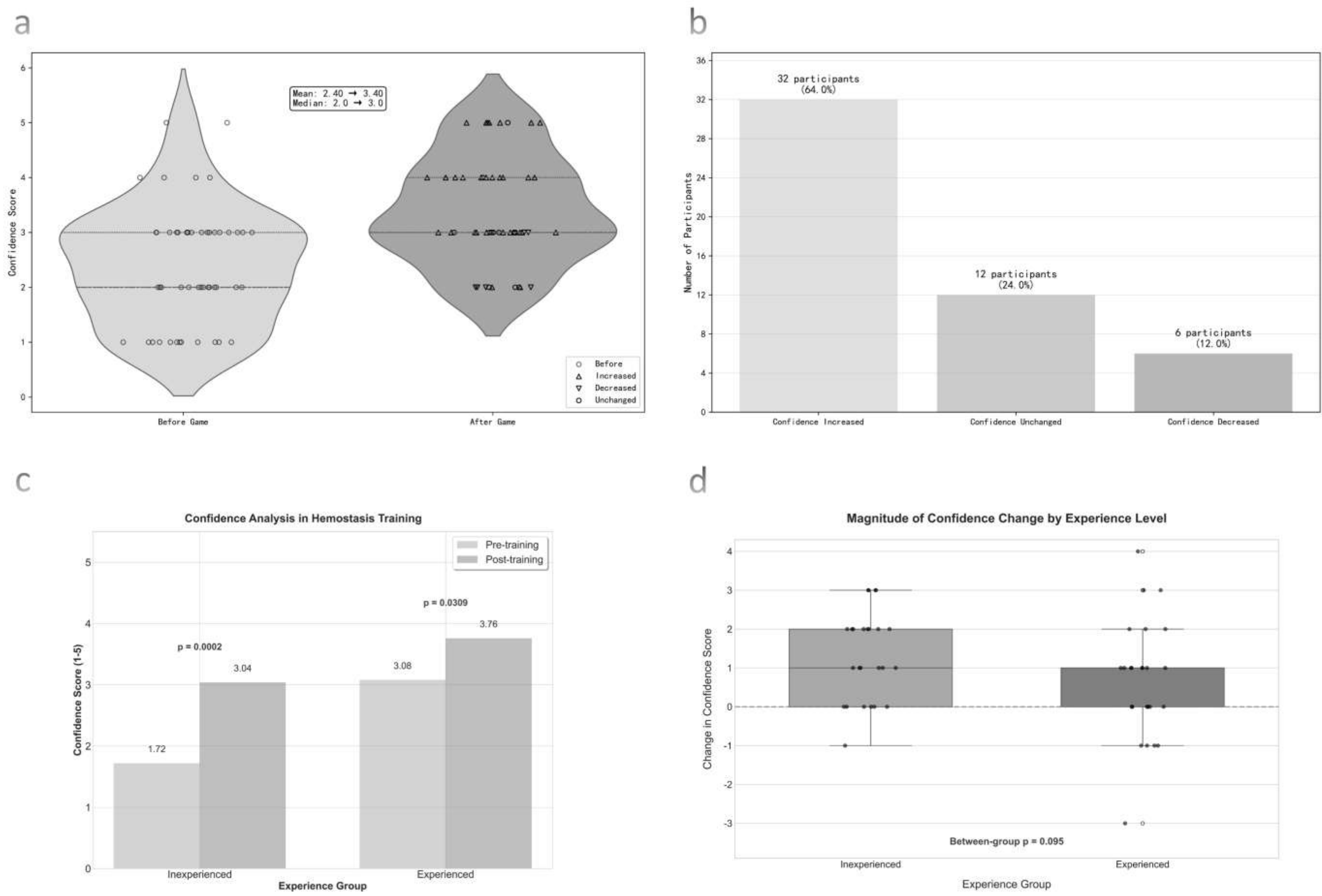


Figure 2. Confidence outcomes following hemostasis training.

- (a)Violin plots showing pre- and post-training confidence distributions, with hollow markers indicating individual scores and marker shapes denoting the direction of change.
- (b)Categorical distribution of confidence changes.
- (c)Stratified pre- and post-training confidence scores for inexperienced and experienced participants, presented using grayscale bar charts and within-group p-values.
- (d)Comparison of confidence-change magnitude by experience level using box plots, showing greater improvement in the inexperienced group.

## Secondary Outcome:

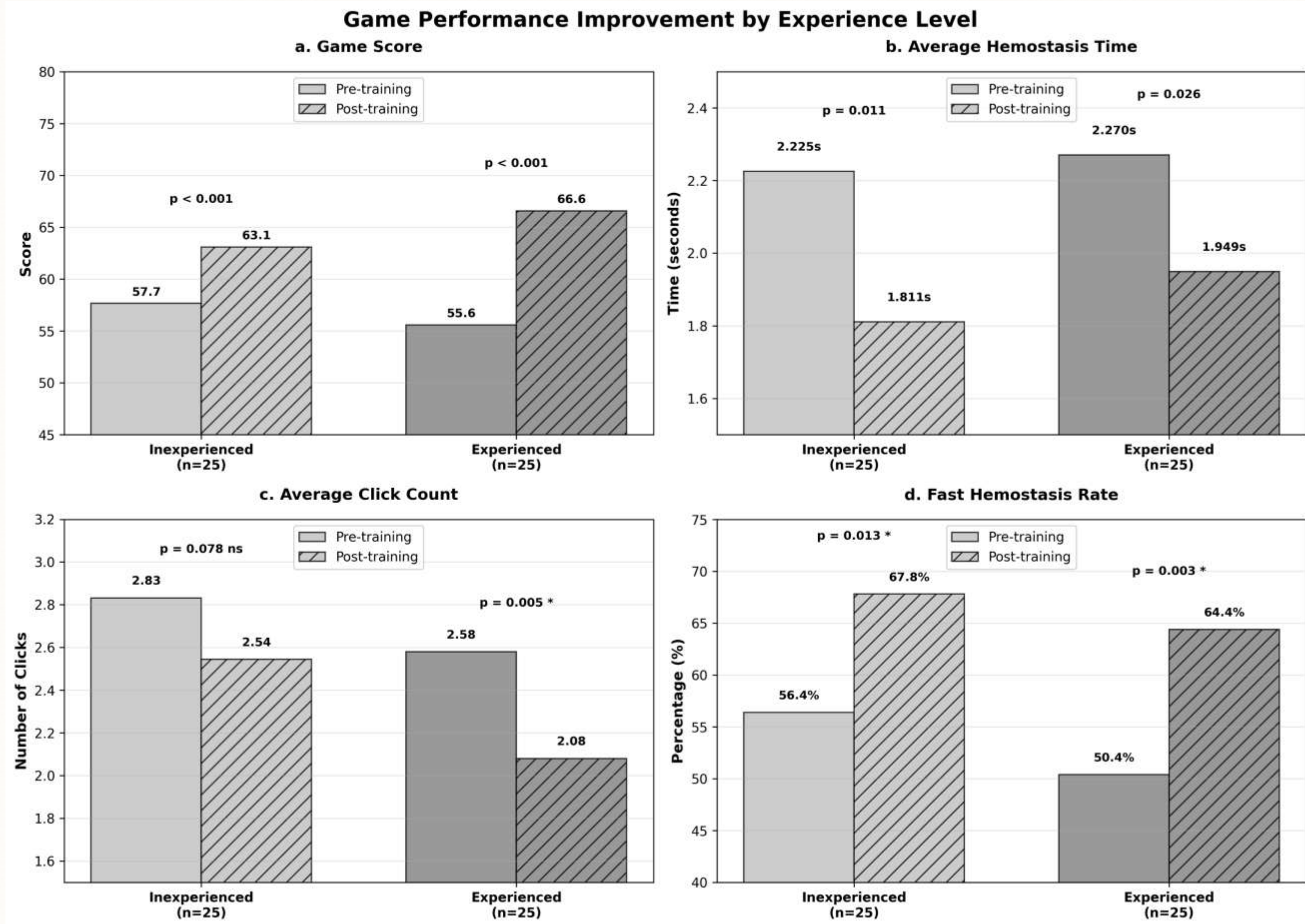


Figure 3. Game Performance Improvements by Experience Level.

- (a) Scores: Significant increases in both groups, with greater gains in experienced participants.
- (b) Speed: Both groups showed reduced hemostasis time and increased fast hemostasis rates.
- (c) Efficiency: Average click counts decreased significantly only in the experienced group.
- (d) Fast hemostasis rates: increased significantly in both groups.

## Conclusion

- SurgSmart Hemostasis Challenge is a feasible and engaging mobile tool that significantly improves both self-confidence and technical proficiency in managing laparoscopic bleeding across all experience levels.
- These findings support the potential of gamified, crisis-oriented training to bridge the gap between routine surgical education and high-pressure clinical practice.