

Becoming an A.R.E. User in Science with Big Three AIs

Hiroyuki Okada, M.D., Ph.D.

The University of Tokyo, Graduate School of Medicine,
Center for Disease Biology and Integrative Medicine, Clinical Bioengineering
NGS Expo 2025 | Nara, Japan | N=110 | **Presentation created with Marp**

Abstract

Generative AI (ChatGPT, Claude, Gemini, etc.) has rapidly permeated research activities, but there is a significant gap between actual usage practices and institutional policies/guidelines.

A survey of 110 participants at NGS Expo 2025 revealed that **93.6% use AI daily**, while only 14.3% consistently disclose AI usage in manuscript writing.

Productivity evaluation (7-point scale) averaged 6.17±0.78, with **97.2% reporting improvement**.

93.6% Daily Use	6.17 Productivity	97.2% Improvement	14.3% Always Disclose
---------------------------	-----------------------------	-----------------------------	---------------------------------

Generative AI Timeline (2022-2025)

Date	Event	Provider	Impact
2022.11	ChatGPT (GPT-3.5)	● OpenAI	Shocked researchers
2023.03	GPT-4, Claude 1	● ●	Reasoning & long context
2024.05	GPT-4o, Claude 3.5	● ●	Multimodal
2024.12	GPT-o1	● OpenAI	Reasoning-focused
2025.06	Gemini 2.5 Pro	● Google	2M token context
2025.09	Claude Sonnet 4.5	● Anthropic	Best for coding

The Coding Agent Era

Generative AI	Coding Agent
GPT-5	Codex CLI
Claude 4.5 Sonnet	Claude Code [Subscription 2025/06-]
Gemini 2.5 Pro	Gemini CLI

- **Context Engineering:** Create specifications like CLAUDE.md
- **MCP:** Add specialized tools (like USB-C)
- **/skills:** Pubmed, Canva, Figma, 10x, etc.

CLAUDE.md Example

```
# CLAUDE.md - scRNA-seq Analysis
## Environment
- Python 3.11, scanpy 1.9
- conda activate sc8
## Data Specifications
- Input: adata.h5ad (191,570 cells)
## Constraints
- NEVER fabricate data
- All statistics verifiable
```

Markdown vs XML

Markdown: Simple & Readable
| Organ | Cells | Response |
XML: Verbose & Complex
<table><row><cell>...</cell>

Key Findings

- 1. High Usage vs Low Disclosure**
Daily use 93.6% vs consistent disclosure 14.3%.
Lack of disclosure is a research ethics concern.
- 2. Significant Productivity Gains**
Average 6.17±0.78 (7-point scale), far above neutral 4.0.
- 3. Major Concerns**
Accuracy/reliability, privacy, publication ethics

How to Use the Big Three Generative AIs

Literature Review

Gemini 2.5 Pro

- Up to 1M token input
- **Best Google search integration**
- High long-context retention

"Summarize 10 years of Treg differentiation research:
1. Major discoveries
2. Methodological advances
3. Unresolved questions
Comprehensive analysis of ~700 papers"

Data Analysis

Claude 4.5 Sonnet

- Best coding capability
- Excellent Python + R
- High error correction accuracy

"Create complete Python/R RNA-seq workflow:
- QC, normalization
- DESeq2 differential expression
- Heatmap, GO analysis
Reproducible code with comments"

Manuscript Writing

GPT-5

- Journal style compliance
- **Human-like expression**
- **Diagrams, multimodal**

"Revise manuscript based on reviewer comments:
- Clarify logical flow
- Ensure figure consistency
- Strengthen statistics
[Reviewer comments + manuscript]"

A.R.E. System (AI-assisted Audience Response Engagement)

Enables real-time conference surveys and manuscript publication within 24 hours.

All presentations created with Marp (Markdown-based), implementing real-time data visualization.

Implementation Steps

Step 1: Google Forms

7-point equal-interval scale, free & unlimited

Step 2: Google Sheets API

Python gspread, real-time aggregation every 30 sec

Step 3: Python Statistical Analysis

pandas/matplotlib/scipy, auto-generate graphs

Step 4: Marp Auto-Update

marp presentation.md --preview --watch

Real-time Markdown slide updates

Step 5: Claude Code Assistance

Statistical interpretation, Abstract/Results creation, debugging

Technology Stack (All Free/Low-Cost)

- Google Forms + Sheets: Free
- Python (gspread, pandas, matplotlib): Open Source
- **Marp CLI**: Markdown to slides (Open Source)
- Claude Code: API fee or Pro subscription

Three Core Values of A.R.E.

- **Real-time**: Update results during presentation
- **Cost-efficient**: No commercial tools needed, fully OSS
- **Reproducible**: Code & data published, reusable

Benefits of Marp Slide Creation

- **Markdown syntax**: Simple and highly readable
- **Version control**: Git-friendly diff management
- **Programmable**: Python scripts for auto image path insertion
- **Consistency**: Unified design with theme application
- **Lightweight**: Lighter than PowerPoint, easy collaboration

Primary Use Cases (N=110, multiple choice)

- Literature search & review (71.8%)
- Code generation & debugging (71.8%)
- Data analysis consultation (66.4%)
- Manuscript/report writing assistance (59.1%)
- Experimental design (40.9%)

Commercial Tools vs A.R.E.

- **Mentimeter/Slido**: \$10-50/month, data ownership issues
- **A.R.E.**: Completely free, data sovereignty, unlimited customization

Conclusions and Recommendations

Demonstrated a disclosure gap in generative AI research use.

Institutions should develop guidelines addressing researcher concerns. Publishers need to unify policies.

Generative AI significantly improves research productivity (average 6.17/7.0, 97.2% report improvement).

Establishing an ethical framework will maximize benefits.

Thank you for your cooperation. This abstract and presentation slides were created with Claude Code (Anthropic).

References:

- Marp: <https://github.com/marp-team/marp>
- Claude Code Best Practices: <https://www.anthropic.com/engineering/claude-code-best-practices>
- Practical Compass for scRNA-seq (Okada): <https://link.springer.com/article/10.1007/s11914-023-00840-4>