

# VR PhytoLab

Development and assessment of a **Virtual Reality laboratory** for Thin Layer Chromatography in phytotherapy practice.

4.08 / 5

behavioural intention to keep learning in VR

$\alpha = .951$

reliability of the 25-item acceptance scale

30

Pharmacy volunteers, 10 sessions

Learner perceptions — six constructs

1–5 Likert

4.08

## Behavioural intention

After one session, students plan to keep using it



Post-procedure TAM survey at Hanoi Medical College · N = 30 · 25 items ·  $\alpha = .951$ .



### Try it at the booth

Put on the Meta Quest 3 and run the TLC experiment — [fit.neu.edu.vn/edtechlab](http://fit.neu.edu.vn/edtechlab)

## THE SYSTEM

### A complete pharmacognosy lab — inside a headset.

#### Three working zones, one room



(a)



(b)



(c)



(d)

UNITY META QUEST 3 HAND TRACKING STANDALONE — NO PC

- 1 Chemicals area** — every reagent used in the TLC exercise, shelved and labelled.
- 2 Laboratory tools** — test tubes, flasks, pipettes, funnels, droppers.
- 3 Specialized TLC equipment** — fume hood, water bath, chromatography chamber, desiccator, UV inspection chamber.

Built with **Unity** for the standalone **Meta Quest 3** — controllers and real-time hand tracking, no PC attached. Every instrument, from the fume hood to the UV chamber, behaves like the real one.

- 1 External preparation**  
Theory instruction and a knowledge assessment — before the headset goes on.
- 2 System preparation**  
Enter the virtual lab and learn the interactions — grab, pour, scoop, open.
- 3 Experiment execution**  
Sample prep, substrate marking, solvent prep, the chromatographic run, observation.
- 4 System-based analysis**  
The system measures and assesses outcomes as the student works.
- 5 External analysis**  
Outside VR: calculate results from measured data, draw conclusions.

## FIELD TRIAL · PHARMACY PROGRAM · HANOI MEDICAL COLLEGE



30

Pharmacy volunteers ran the full TLC procedure in VR



10

hands-on evaluation sessions at the college



3

Meta Quest 3 headsets running simultaneously per session

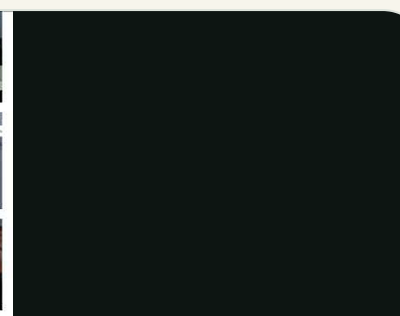
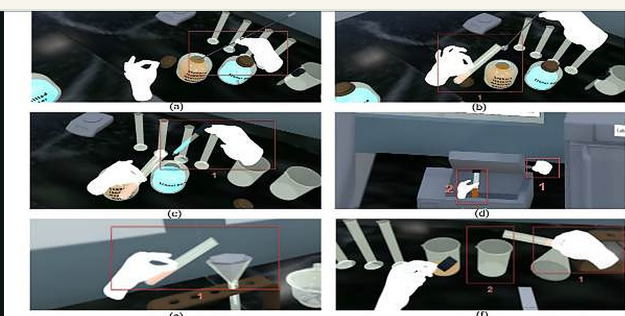
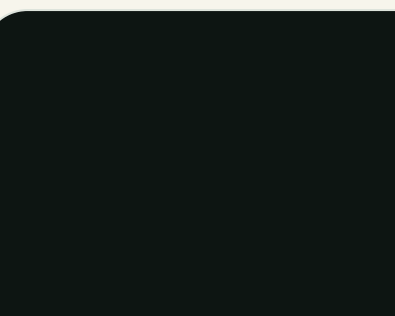


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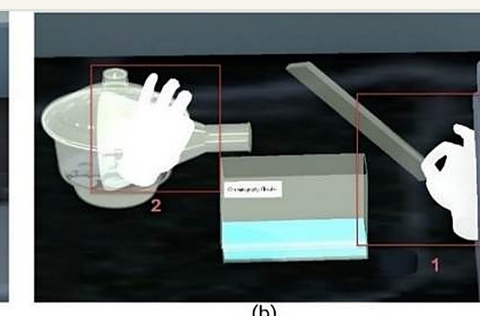
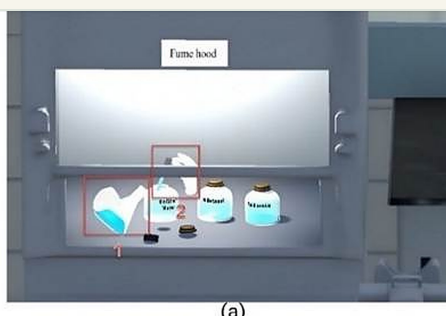
“disagree” responses on any perceived-usefulness item

## WHAT THE LEARNER ACTUALLY DOES

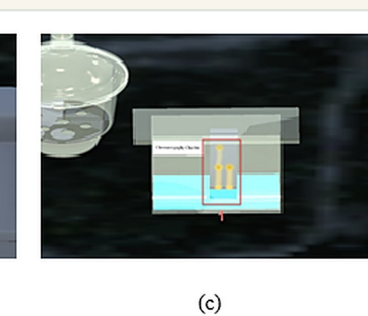
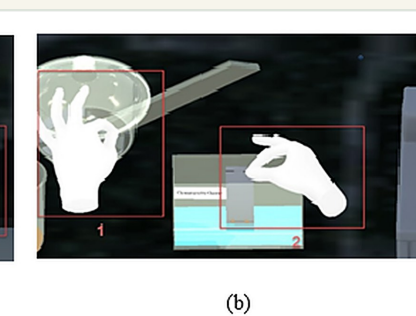
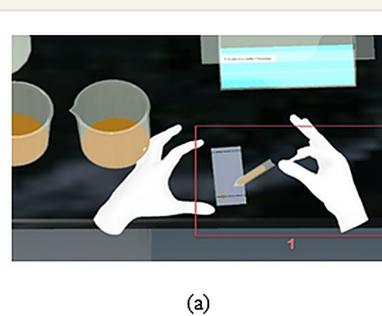
### The full TLC procedure — hands tracked, every step verified.



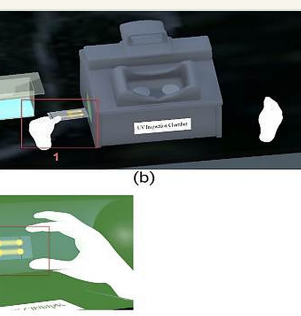
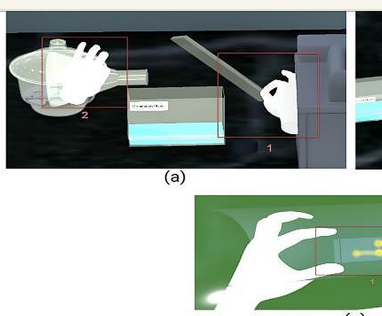
**1 Prepare the sample**  
Scoop the **herbal powder** with the metal spoon, pour it into a test tube, heat in the water bath, then filter the ethanol–herbal mix through a funnel.  
  
The dropper auto-draws **90% ethanol** on contact — no mis-measuring.



**2 Prepare the solvent**  
Mix the mobile phase under the **fume hood**, then transfer it into the chromatography chamber.  
  
The system **verifies the solution**, and the chamber accepts a pour only when both lids are open — a controlled transfer.



**3 Spot & develop**  
Apply **standard and sample** to the plate with the dropper, add solvent, and insert the spotted plate into the chamber.  
  
Spotting is **auto-detected**; development starts on plate contact and lid closure, results appear when the countdown ends.



**4 Dry, inspect, measure**  
Dry the plate in the **desiccator**, read it in the **UV inspection chamber**, and measure the distance between spots by hand.  
  
Positioning and measurement mirror the **real-world assay** — outcomes are computed from what the student measures.

The system watches each action: it checks the solvent, auto-detects the spotting, and starts development only when the plate is in and the lid is closed — mistakes are caught where they happen.



### Zero chemical exposure

Ethanol, solvent vapour and UV light exist only virtually — hazardous steps are practised safely and repeated at will, with no reagent cost per run.

## METHOD

30 volunteers, 10 sessions, 3 headsets at a time.

- **3 × 10**

three students per session, **each** on a Meta Quest 3, across ten sessions
- **3 phases**

sample preparation → chromatography preparation → **chromatography**
- **25 items**

post-procedure **TAM survey**, five-point Likert scale
-  **$\alpha = .951$**

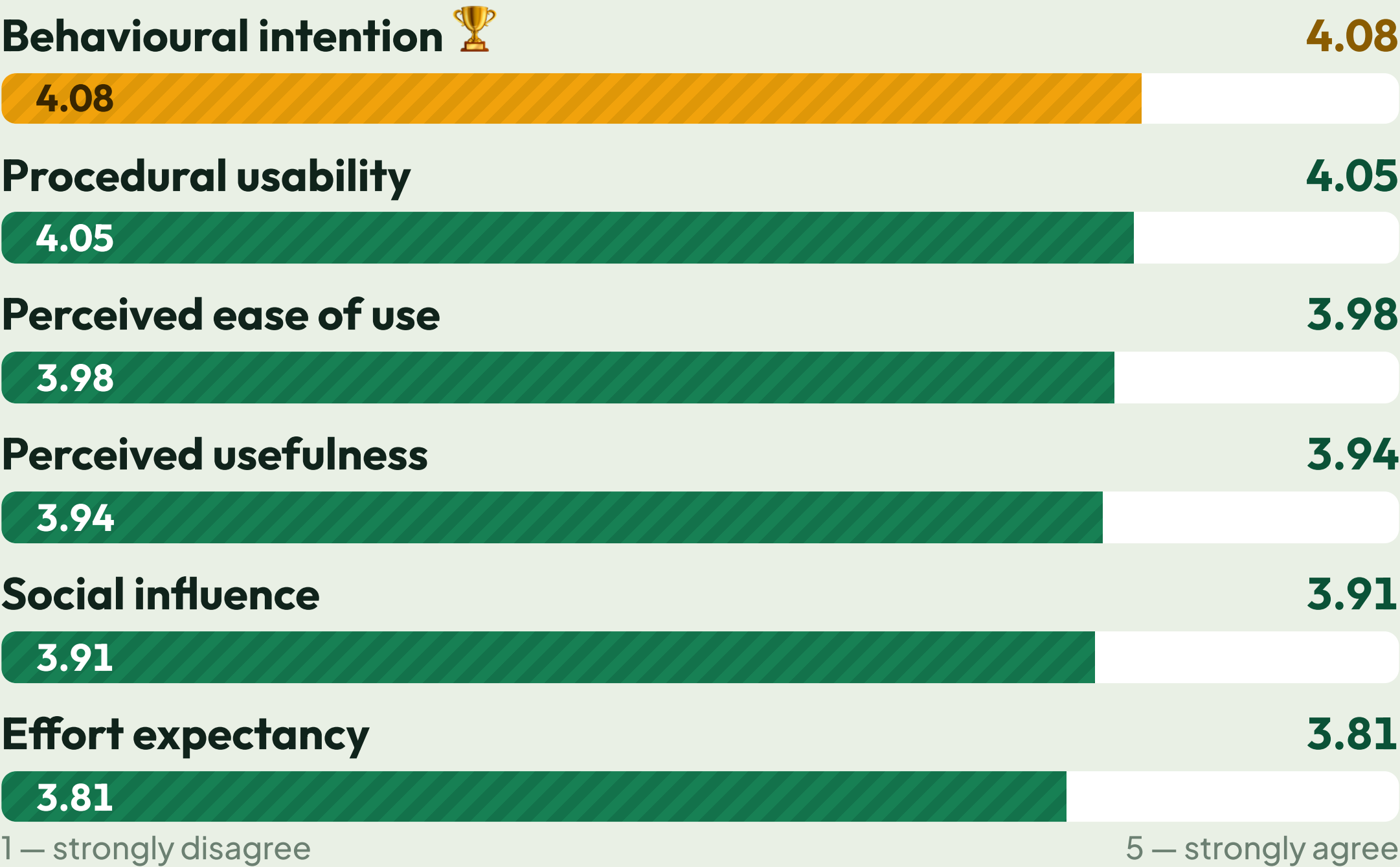
**excellent reliability** across the full scale



A session at **Hanoi Medical College** — the headset view mirrored to the classroom screen while the next group observes.

## RESULTS · ACCEPTANCE

Every construct clears 3.8 of 5.

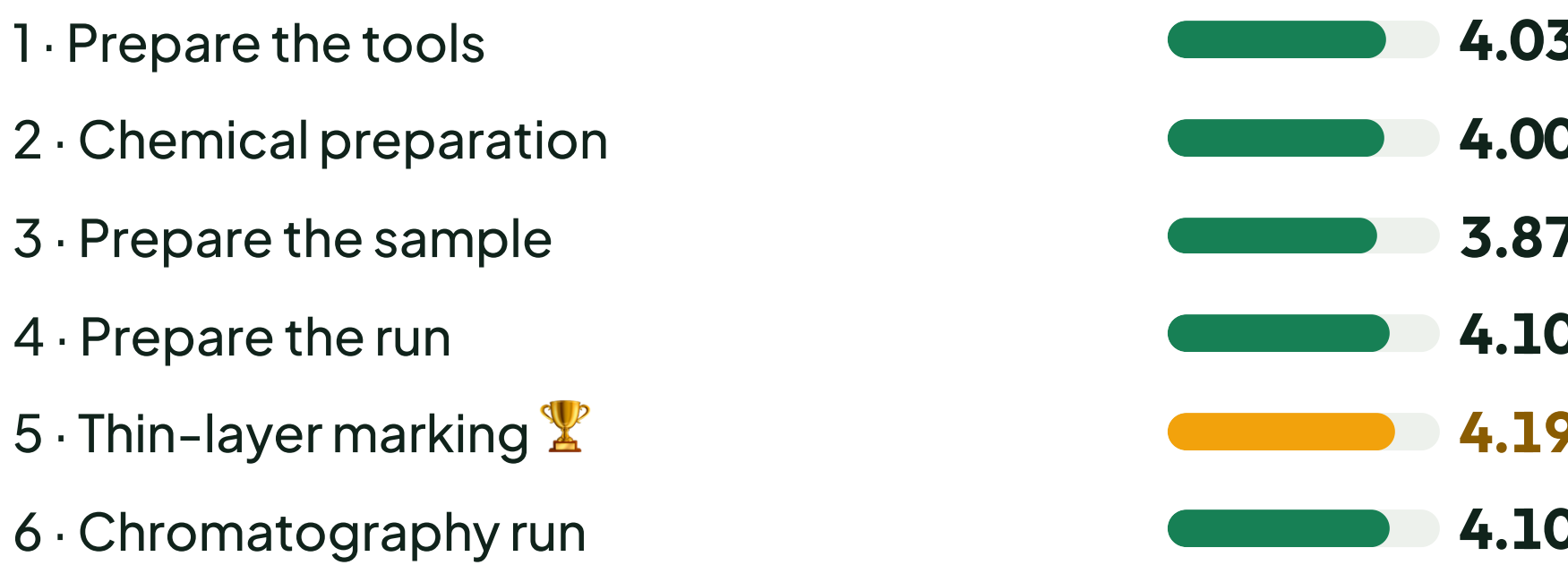


Behavioural intention scores highest (4.08) — after a single session, students intend to keep learning in VR, and **84%** would recommend the system to others.

## RESULTS · BY STEP

Usability, step by step.

All six procedure steps rated 3.87–4.19



Procedural-usability block of the survey — every step of the VR workflow sits well above the scale midpoint.

“Useful in learning?” — not one no.

26% strongly agree 68% agree 6% neutral

**94% agree or strongly agree** the system is useful in learning — mean **4.19**, the highest-rated single item in the survey, with zero negative responses.

## CONCLUSIONS



### The cost barrier is simulated away

Fume hoods, reagents and UV chambers exist virtually — sessions become **consistent and repeatable** without the equipment cost that limits hands-on TLC.



### In the curriculum, not beside it

Integrated into the **Medicinal Plants Practical** course for herbal drug testing — expanding next to analytical chemistry and quality control.



### Scaling is an investment decision

Institutions must invest in infrastructure, put interactive VR scenarios into curricula and **train instructors** — with policy support to keep integration sustainable.



### At this booth

Put on a Meta Quest 3 and run the TLC experiment yourself. Research collaboration welcome at the **Edtech Innovation Lab** · [thaop@neu.edu.vn](mailto:thaop@neu.edu.vn).