



Collaborative VR Anatomy Atlas

Investigating Multi-User Anatomy Learning

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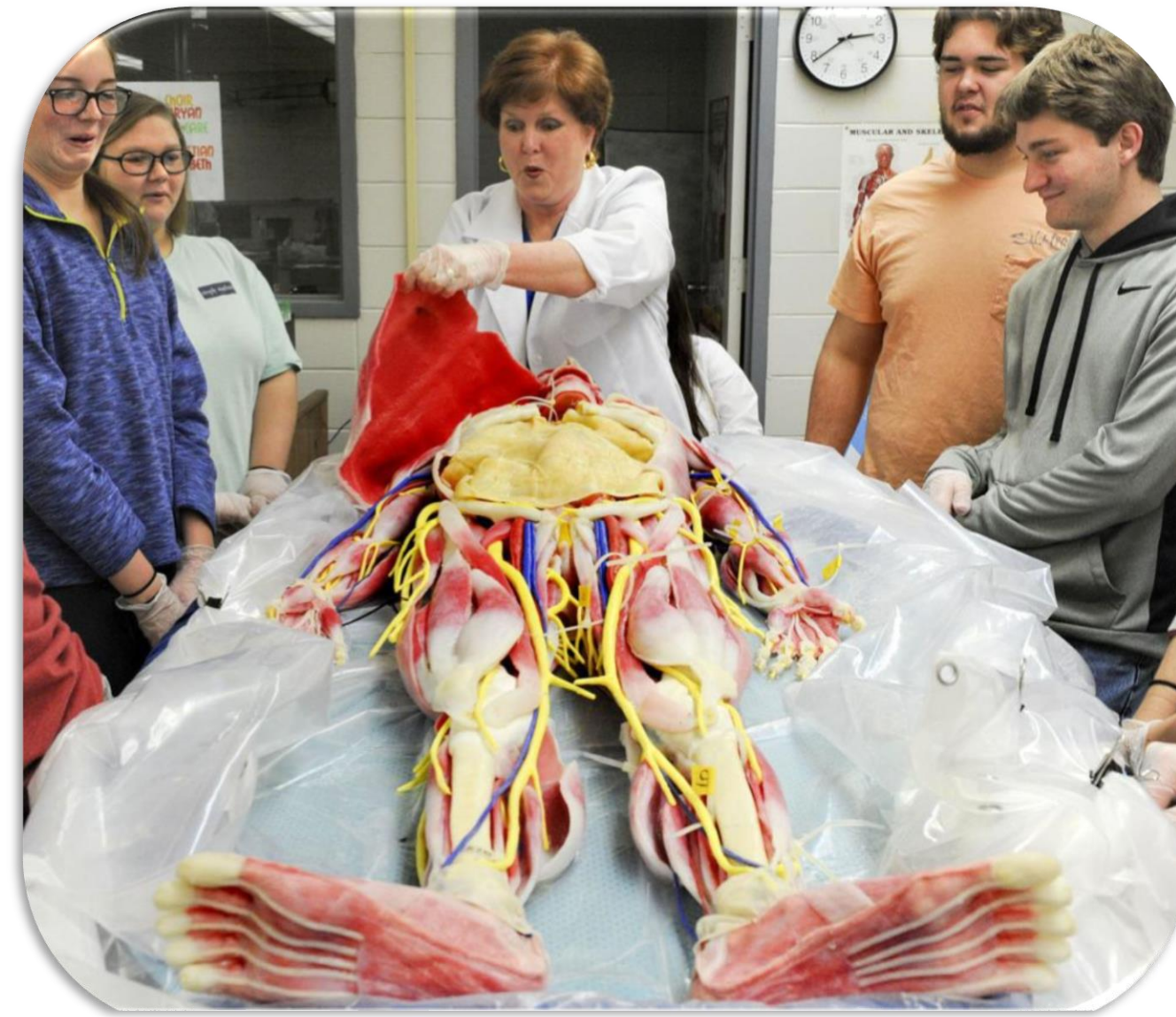
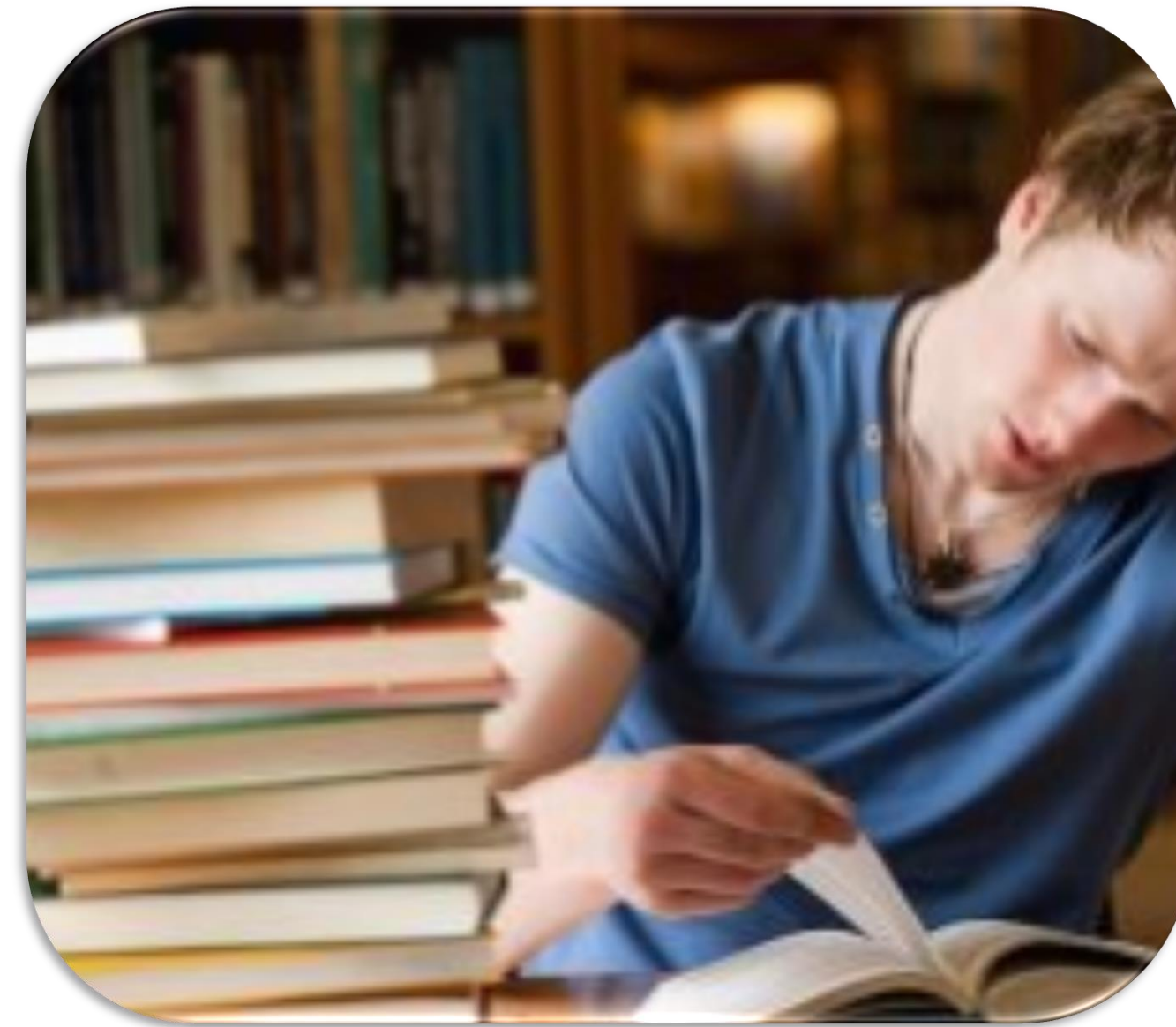
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Limitations of classical anatomy education

[Singal 2020, Bonali 2021]

Availability, costs, interaction, 2D perspective



Limitations of classical anatomy education

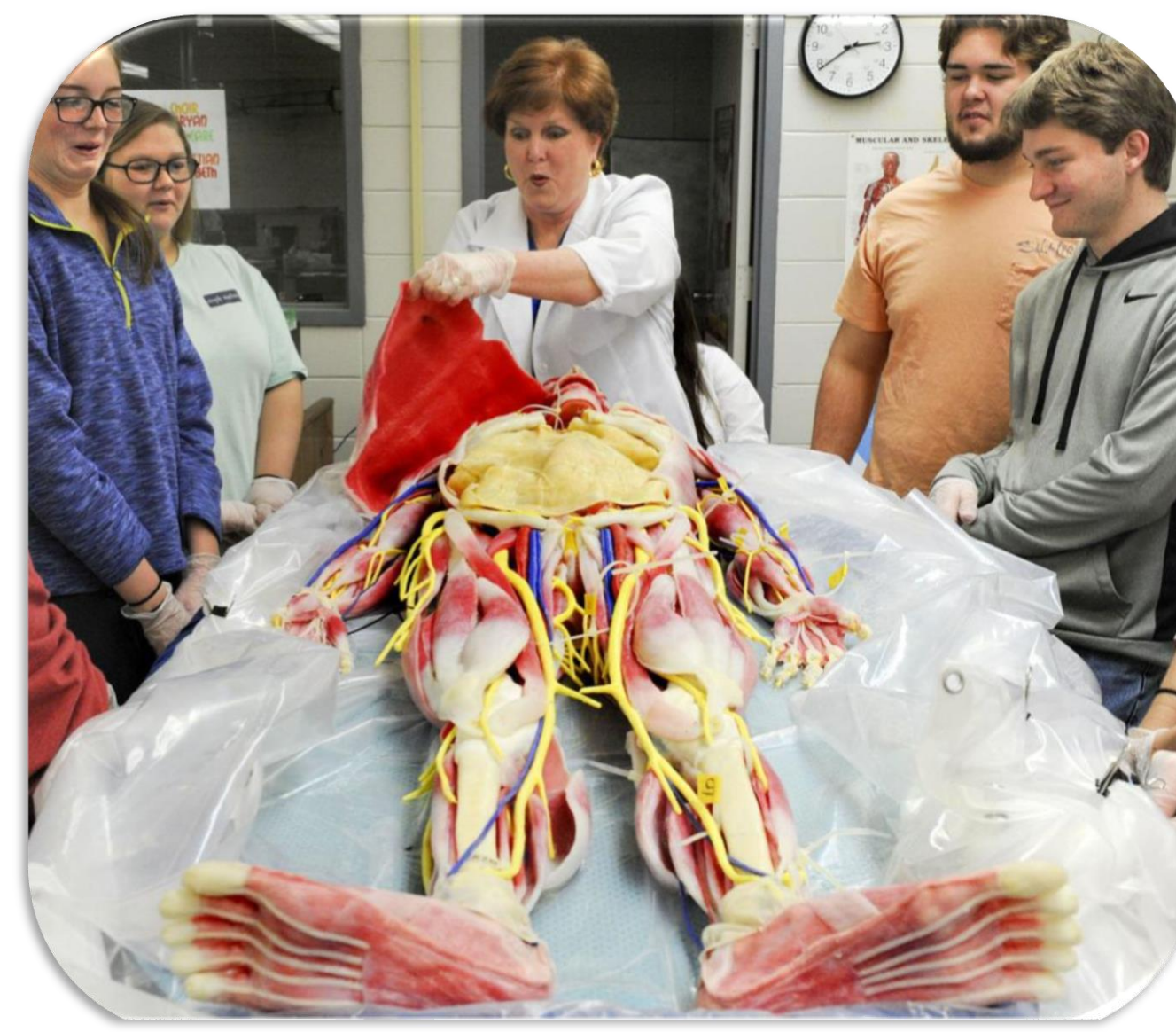
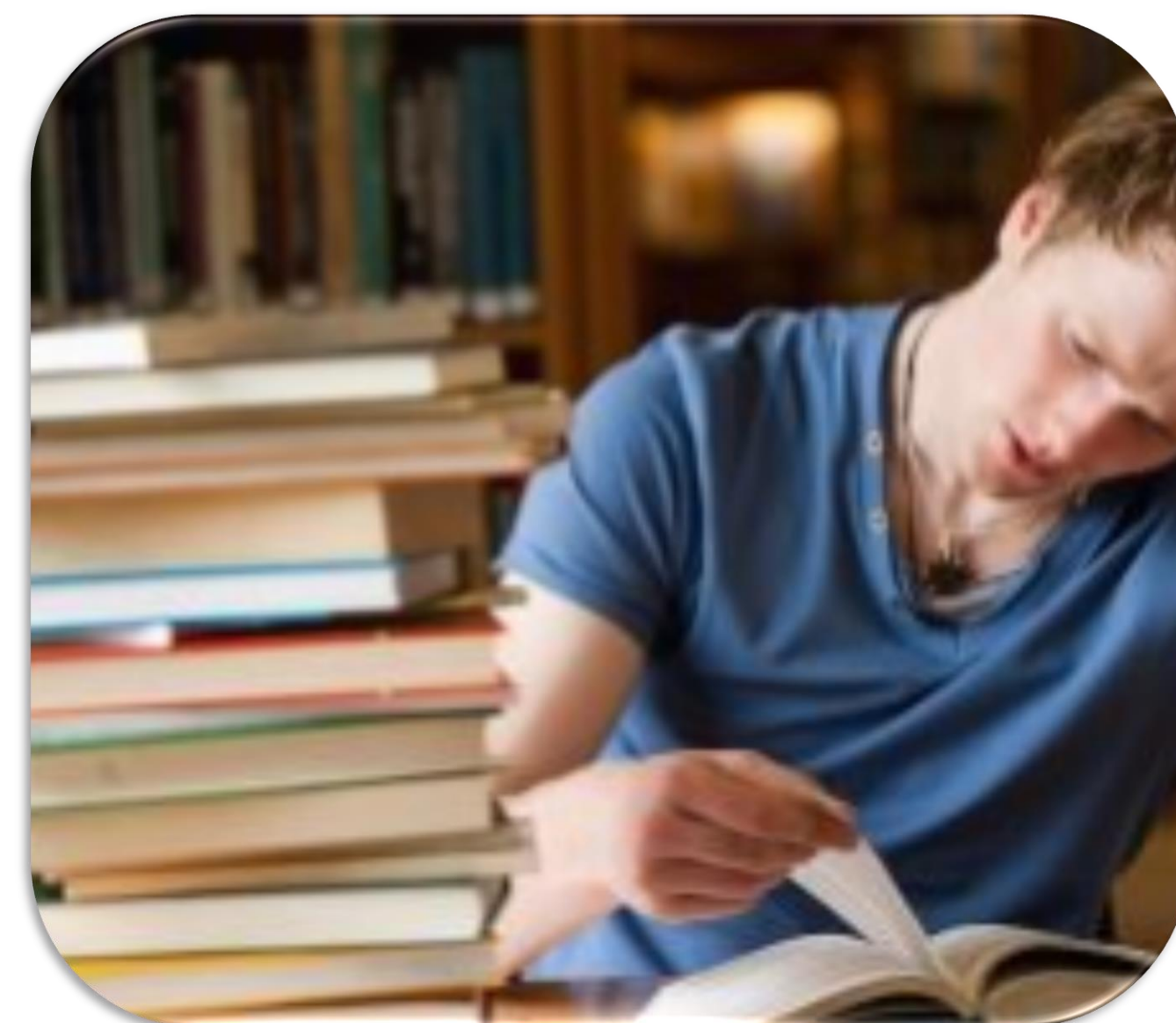
[Singal 2020, Bonali 2021]

Availability, costs, interaction, 2D perspective

VR provides benefits

[Gloy 2022]

Immersion, natural interaction





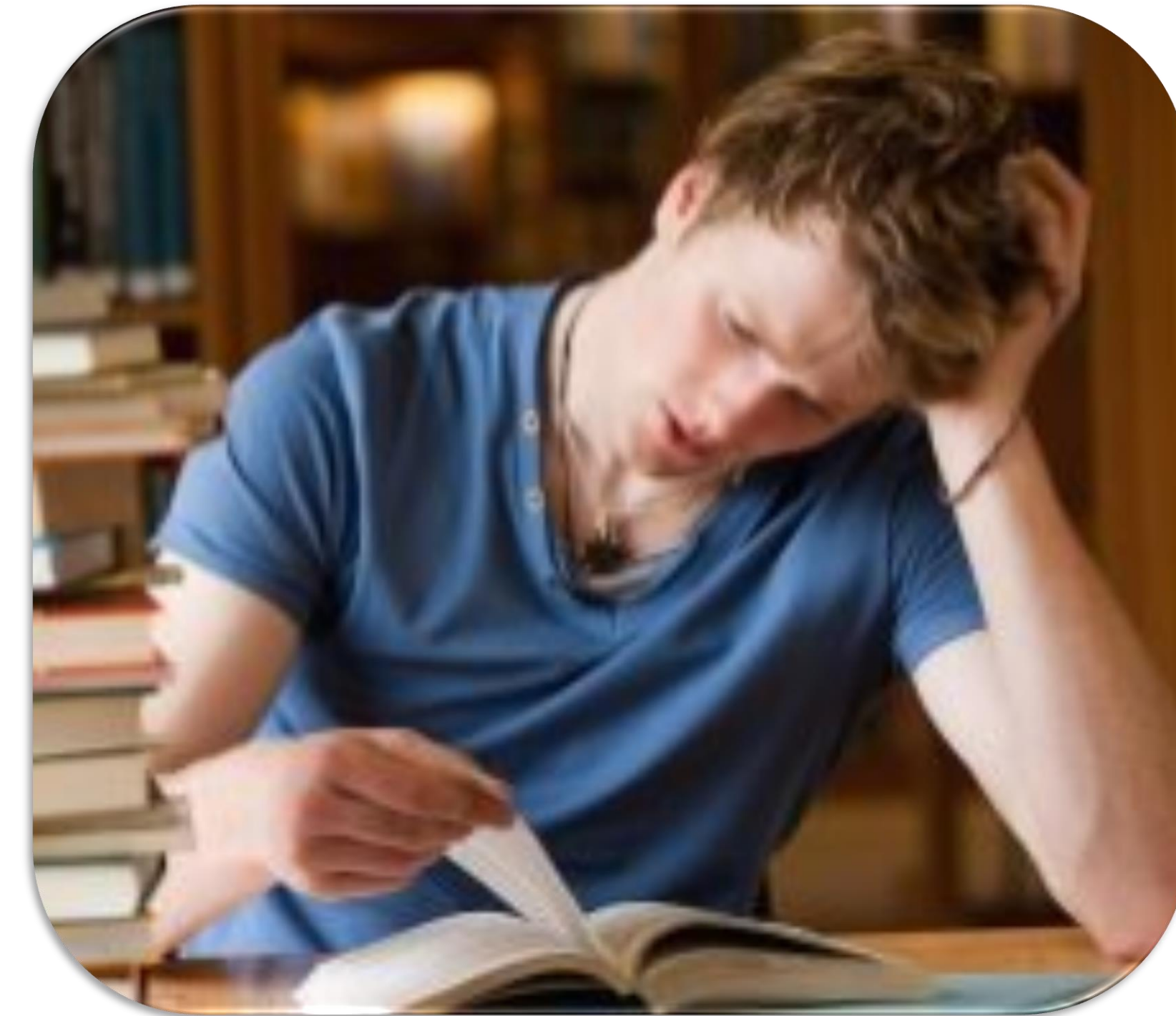
Motivation



Motivation

Solo learning is suboptimal

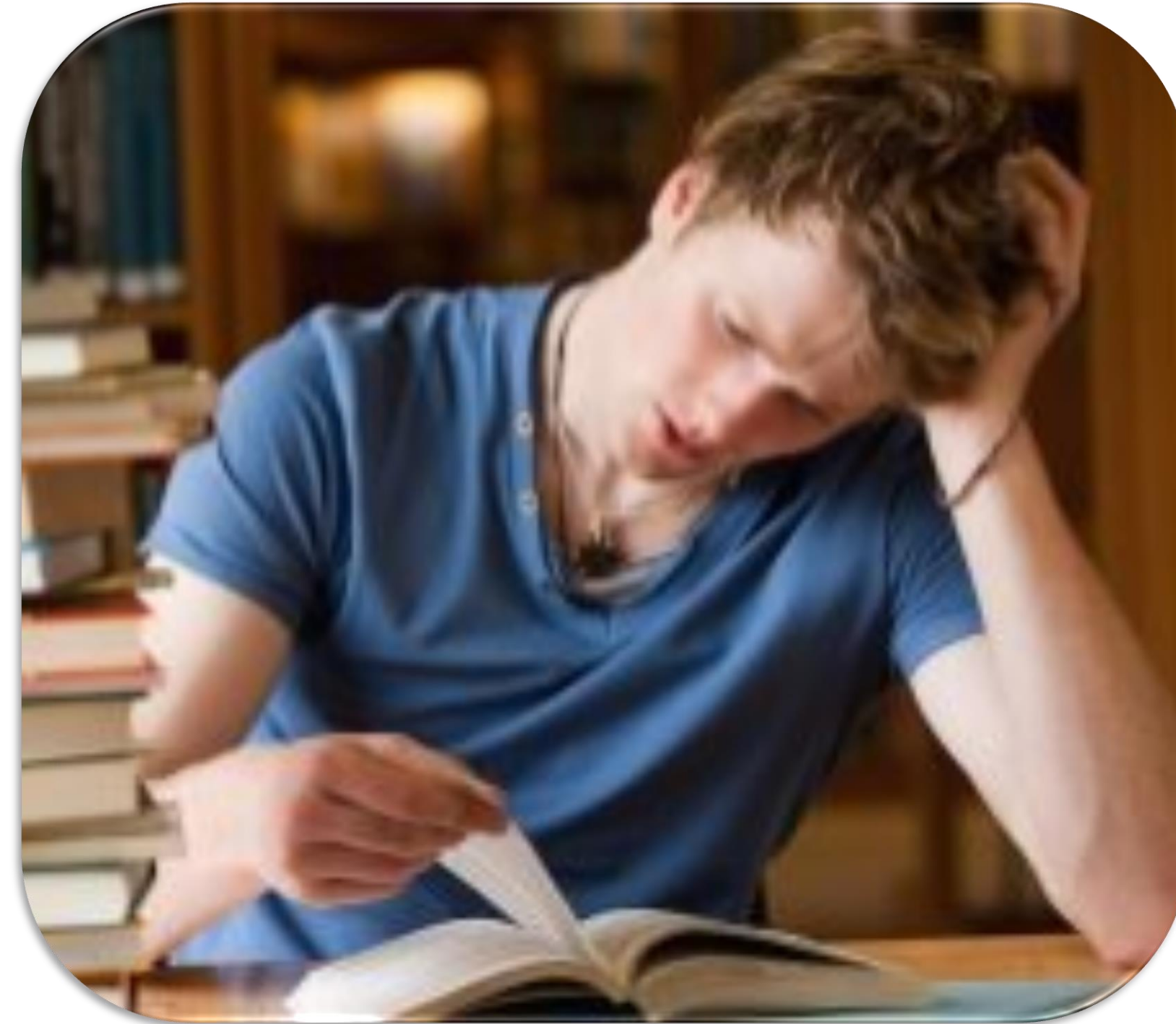
[Laal 2012, Rutherford 2014]



Motivation

Solo learning is suboptimal

[Laal 2012, Rutherford 2014]



Collaboration provides benefits

[Kyndt 2013, Rutherford 2014, Casey 15]

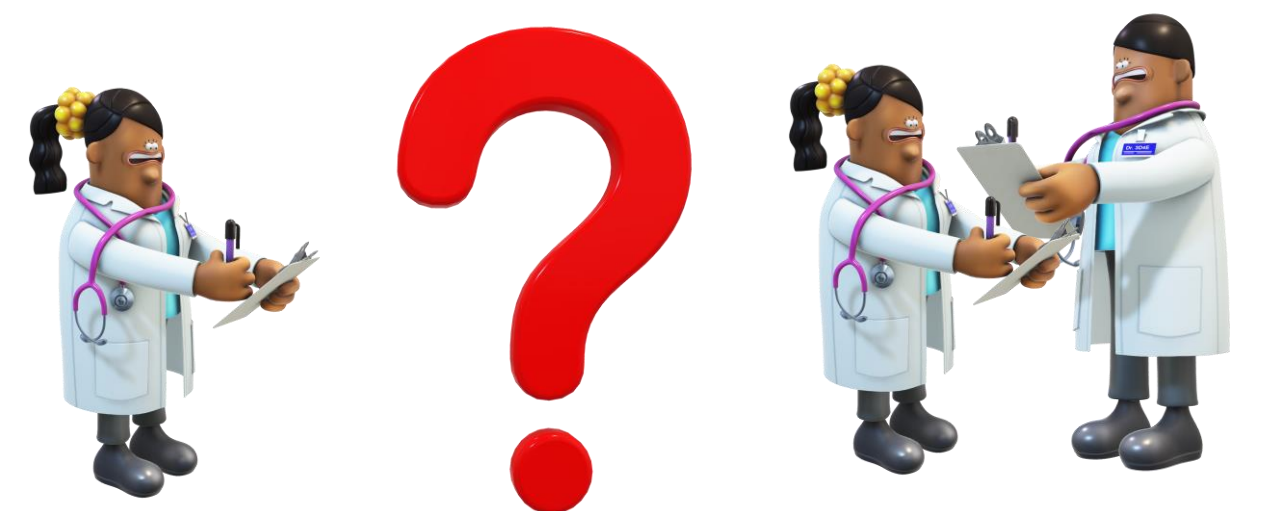


But does collaborative learning work in VR too ?

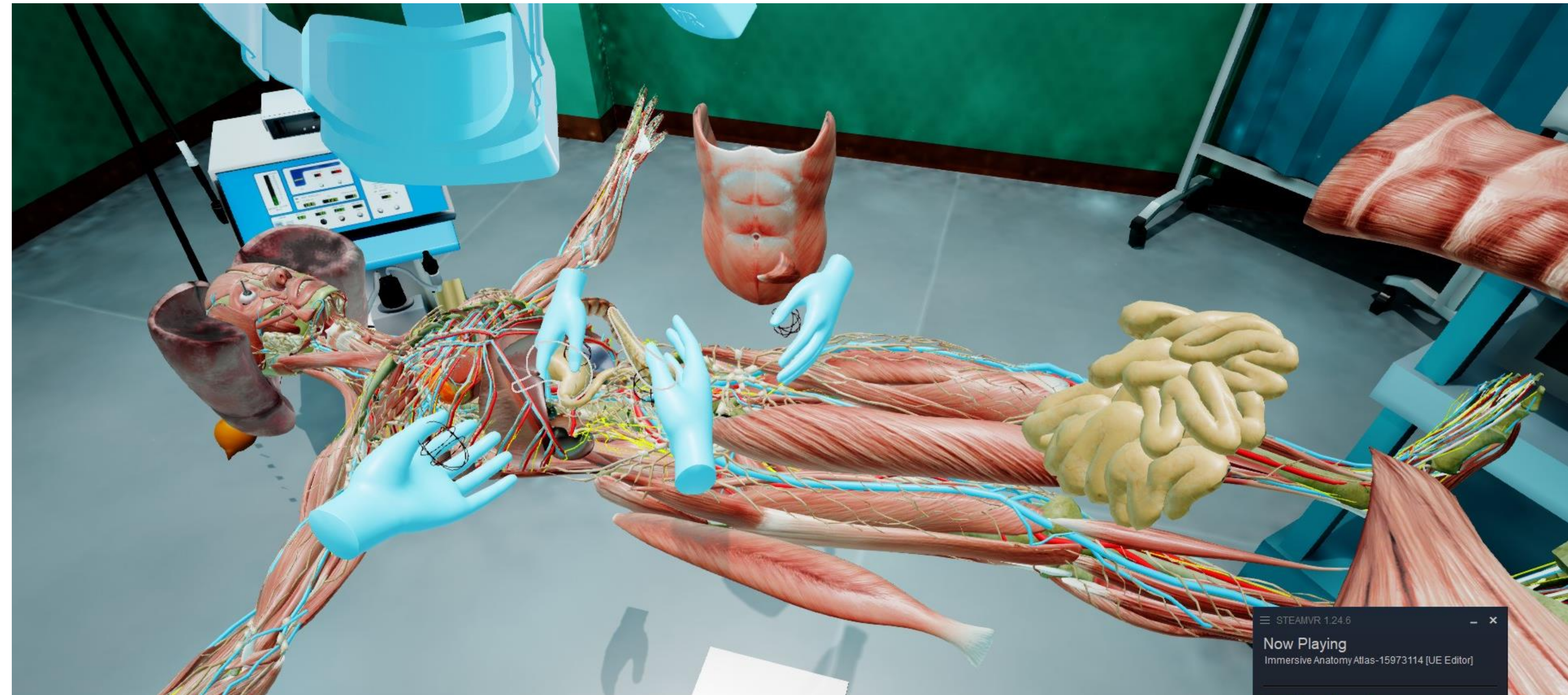
Research Questions

- Does collaboration in VR enhance anatomy learning?
- Does VR affect the learning motivation of university students?
- Are there differences in usability and user experience between individual and collaborative learning?

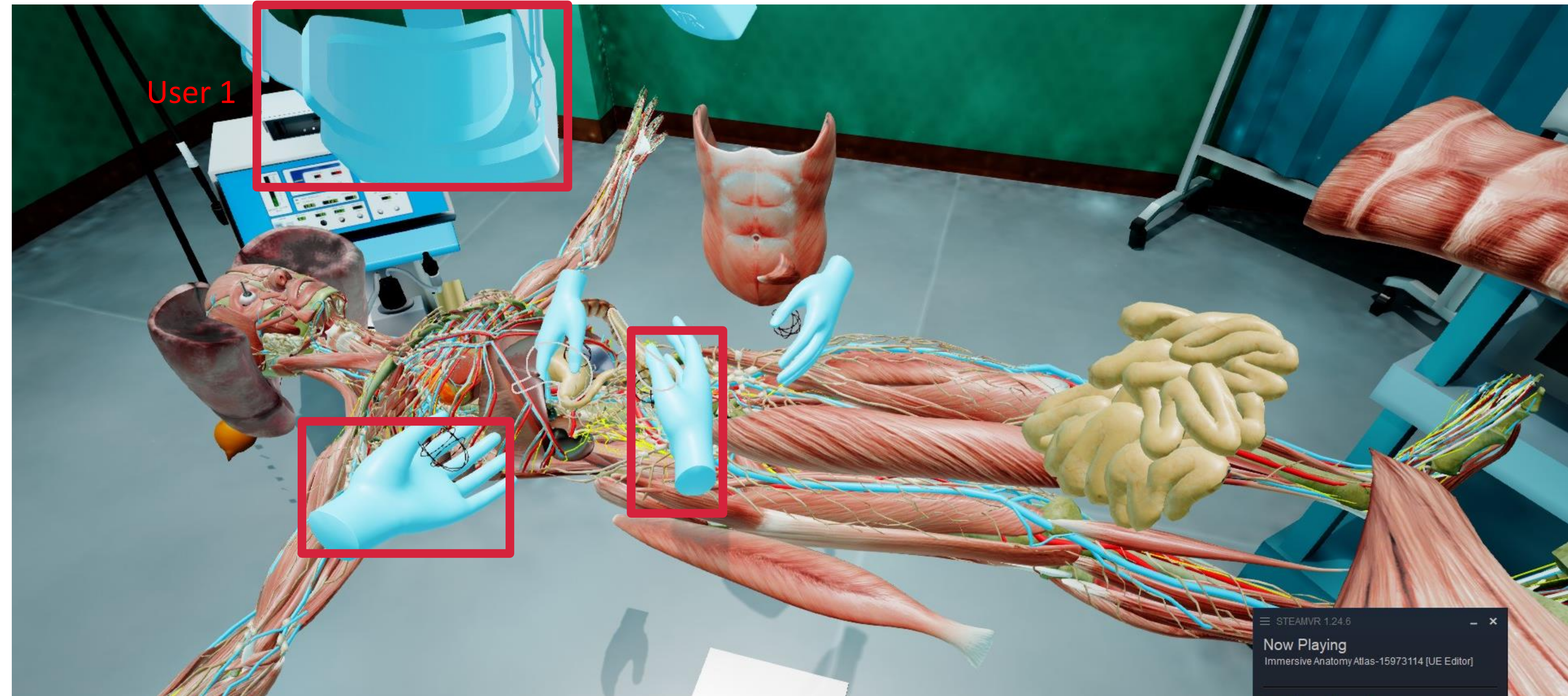
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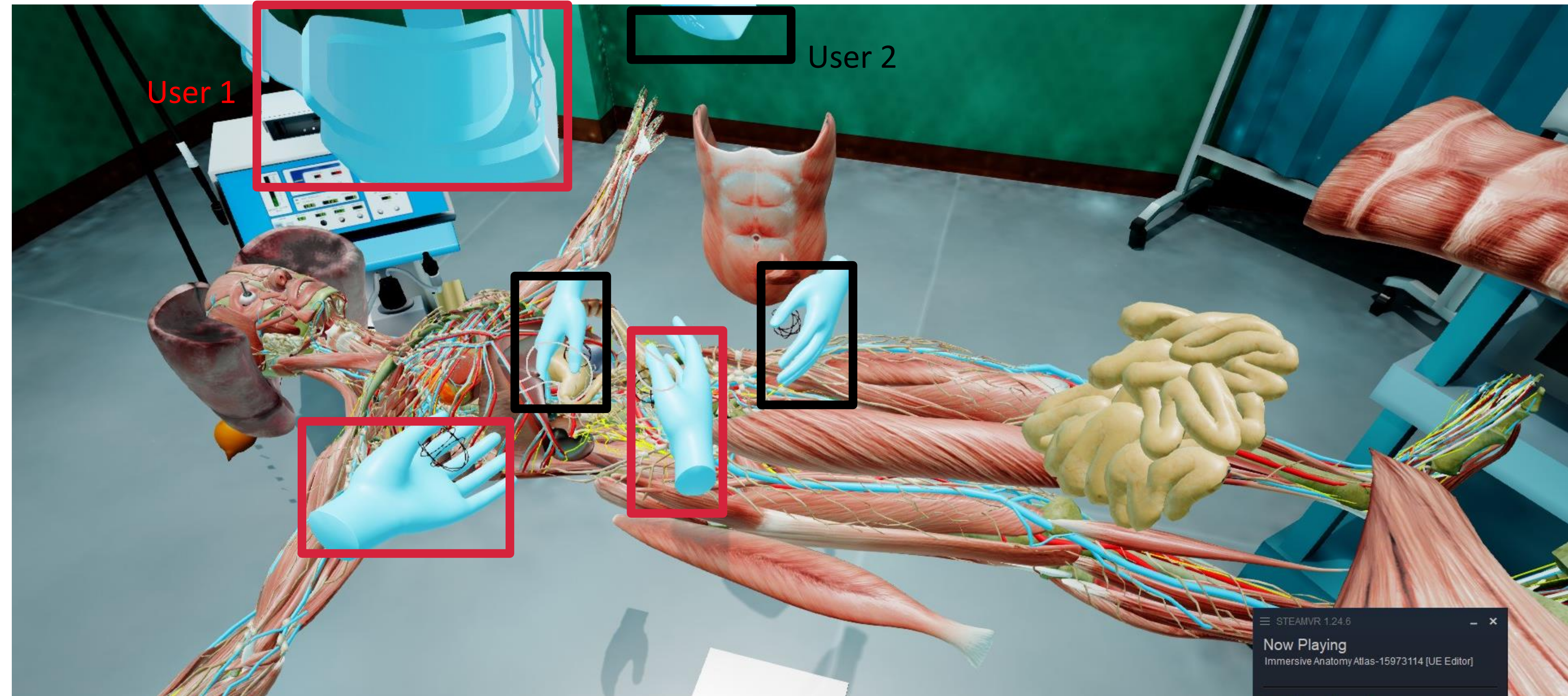
Our Collaborative VR Anatomy Atlas



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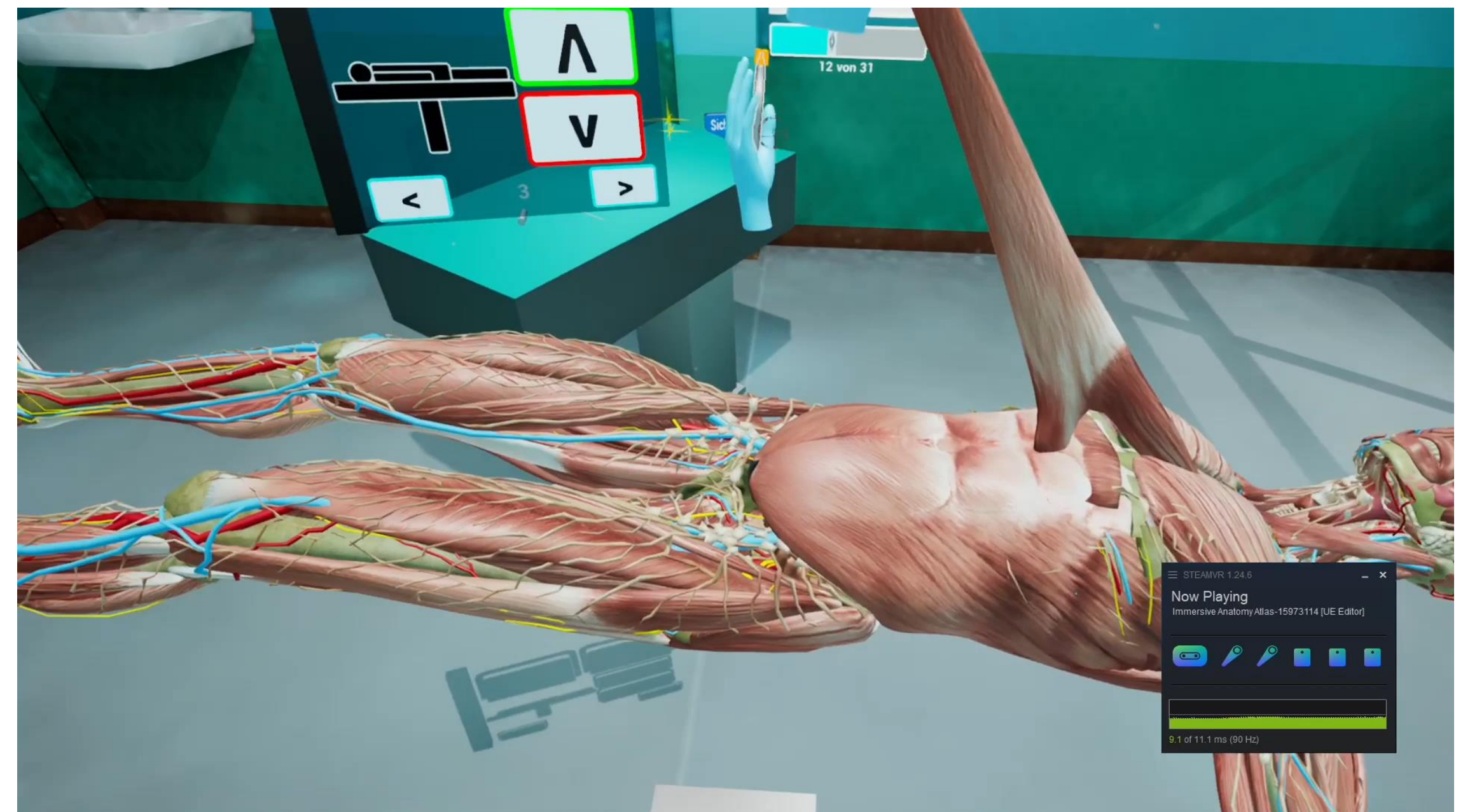


Our Collaborative VR Anatomy Atlas



User Study: Design

- Between-subject design
- Conditions: Single-user (n=11) vs. multi-user (n=22 as pairs)
- Conducted within a laboratory setting
- Participants physically present in multi-user condition



User Study: Tasks

- Discovering human anatomy
- Searching specific organs
- Interacting and learning together in the multi-user condition



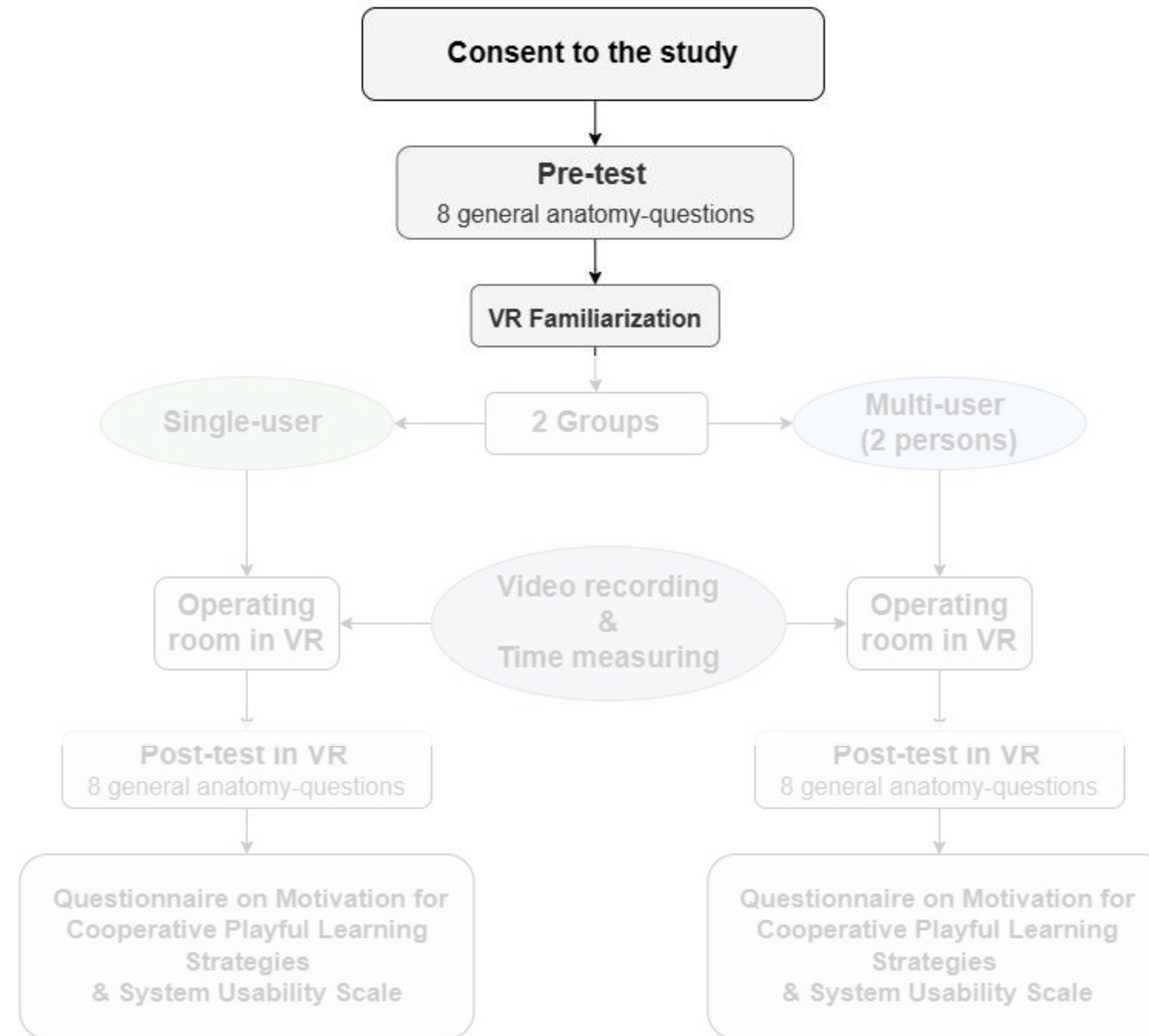
User Study: Demography

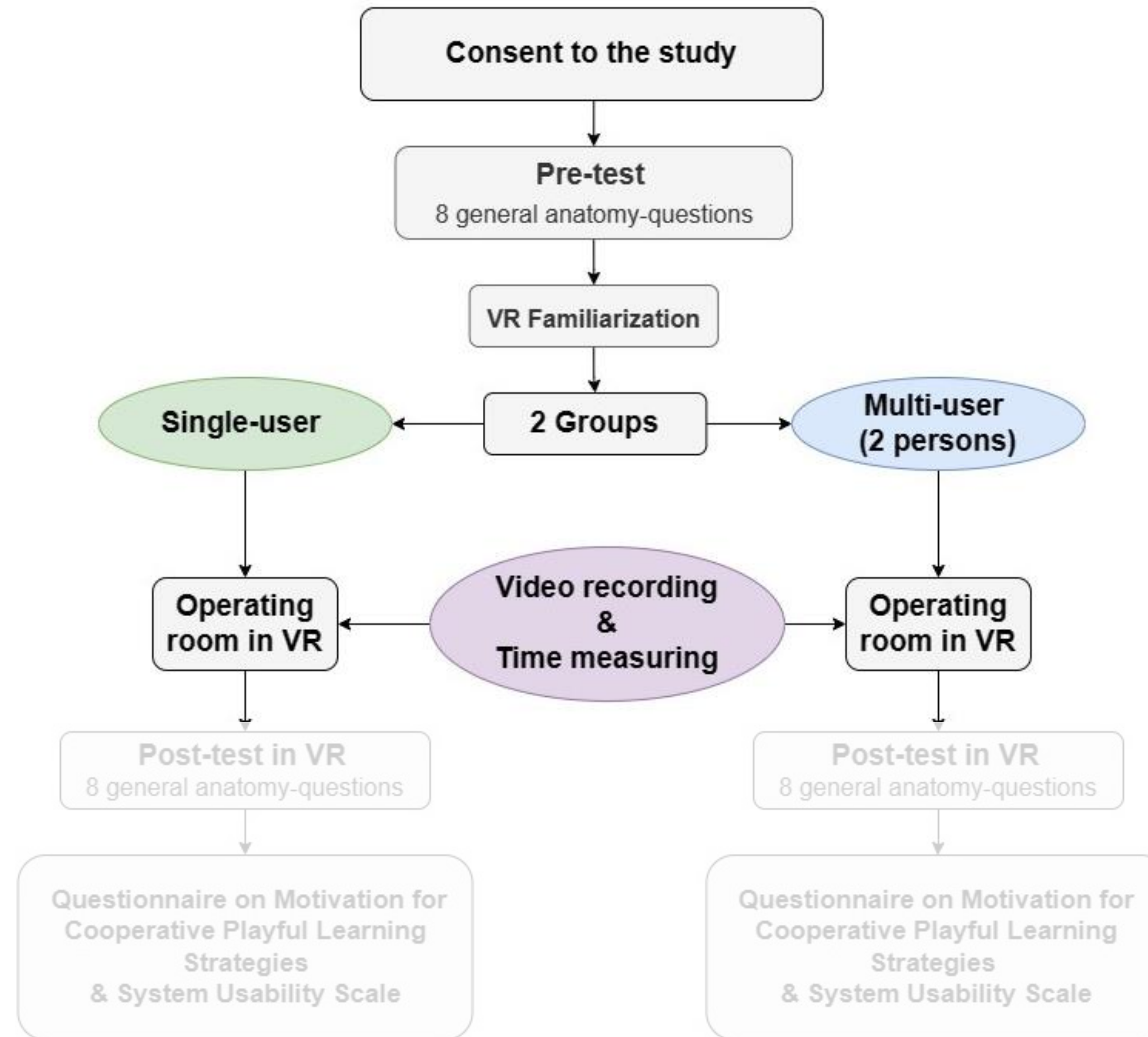
- Participants:
 - 70% men, 30% women
 - Mostly young
 - Mostly university students from various subjects
 - Most users with VR experience



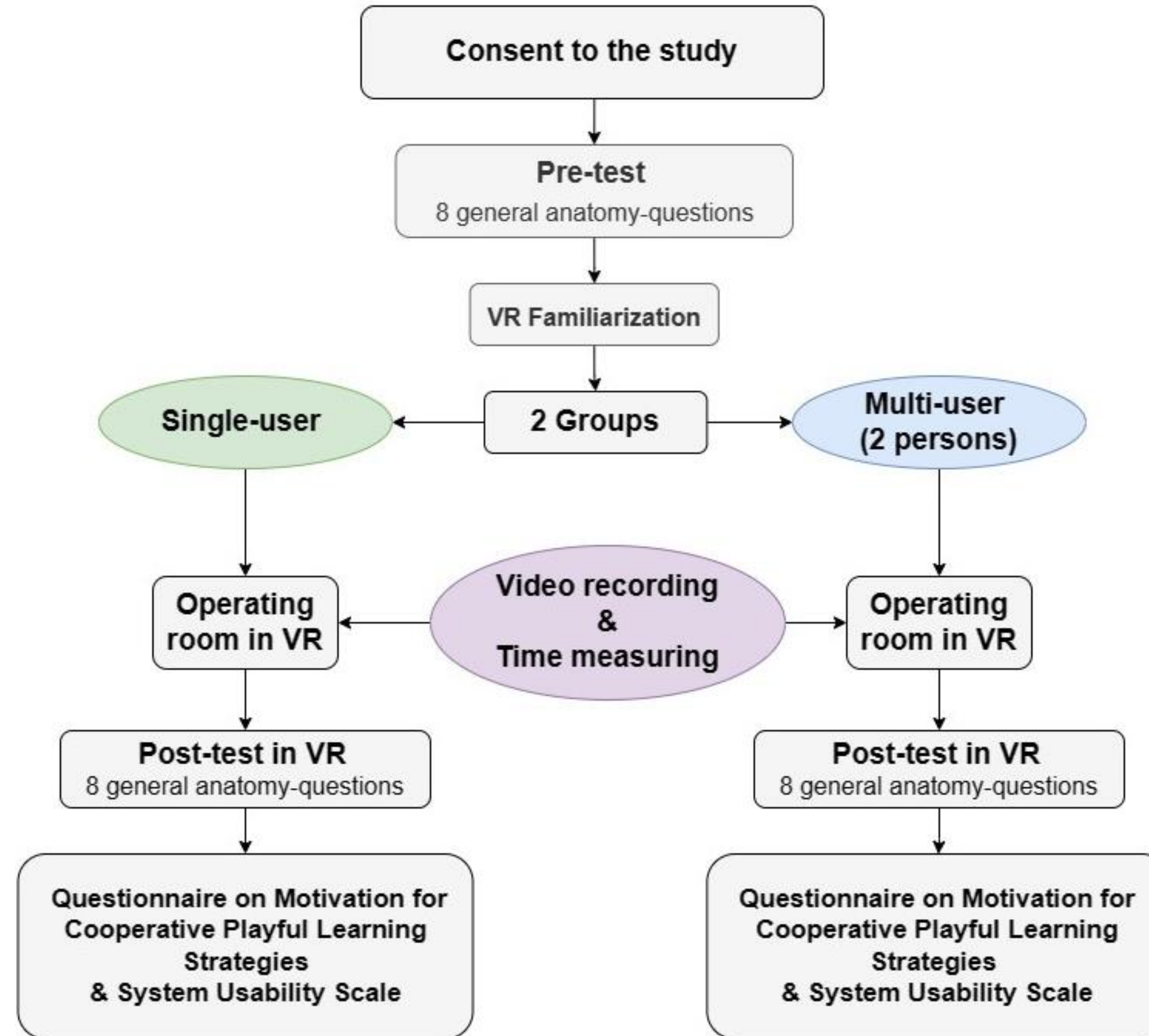
User Study: Measurement

- Learning Progress
 - Own 8-item anatomy questionnaire (two times: Pre-/Post-test)
- Learning Motivation
 - Questionnaire based on motivation for cooperative playful learning strategies (CMELAC) [Manzano-León21]
- Learning Effectiveness
 - Time in VR
- Usability
 - System Usability Scale [Brooke96]



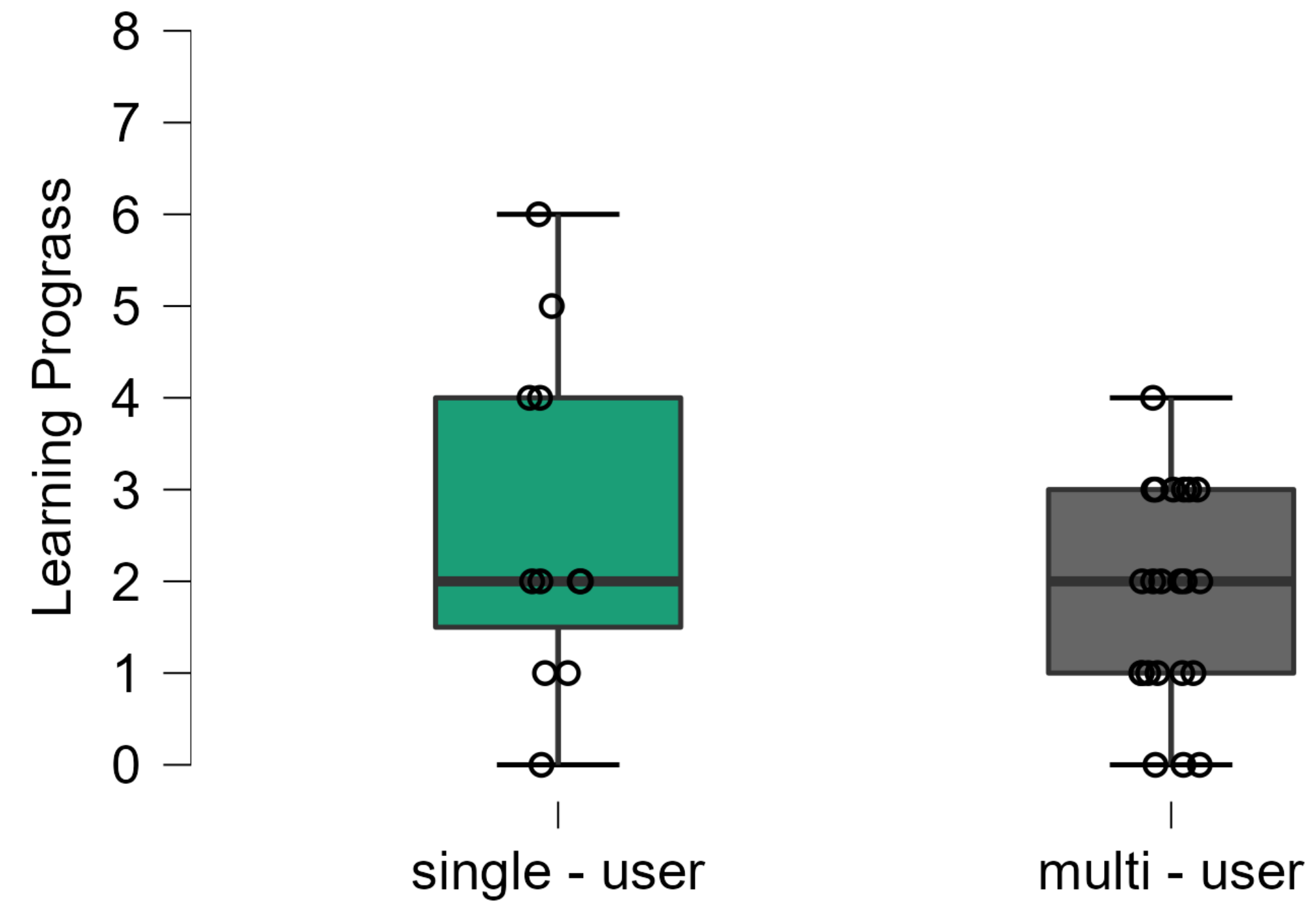


User Study: Procedure

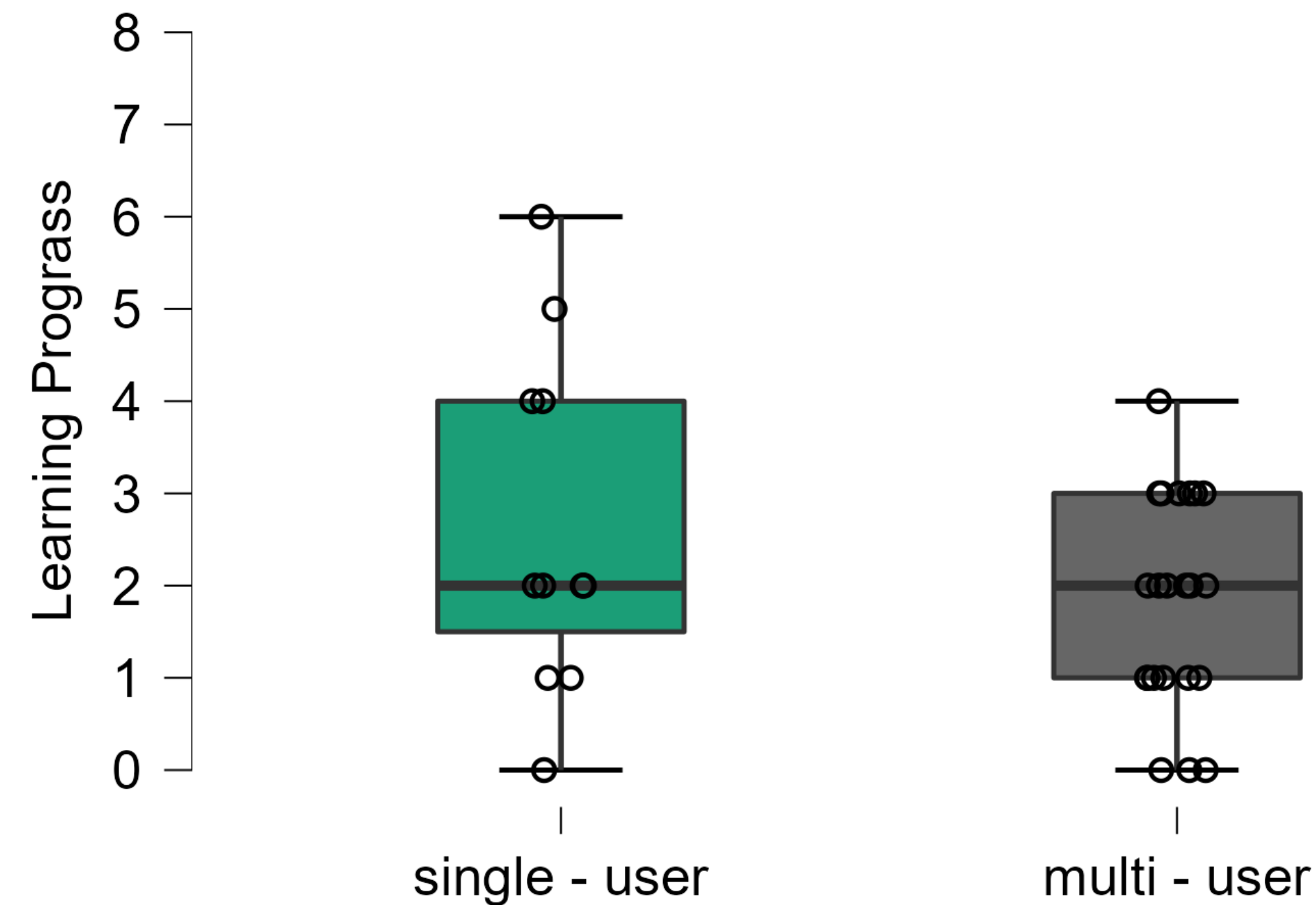


- Learning Progress (Δ of Pre-/Post-test)
 - Number of correct answers
- Test for significance using Independent Samples T-Test
 - Two unrelated groups
 - Normally distributed data (Shapiro-Wilk-Test)

Results: Learning Progress

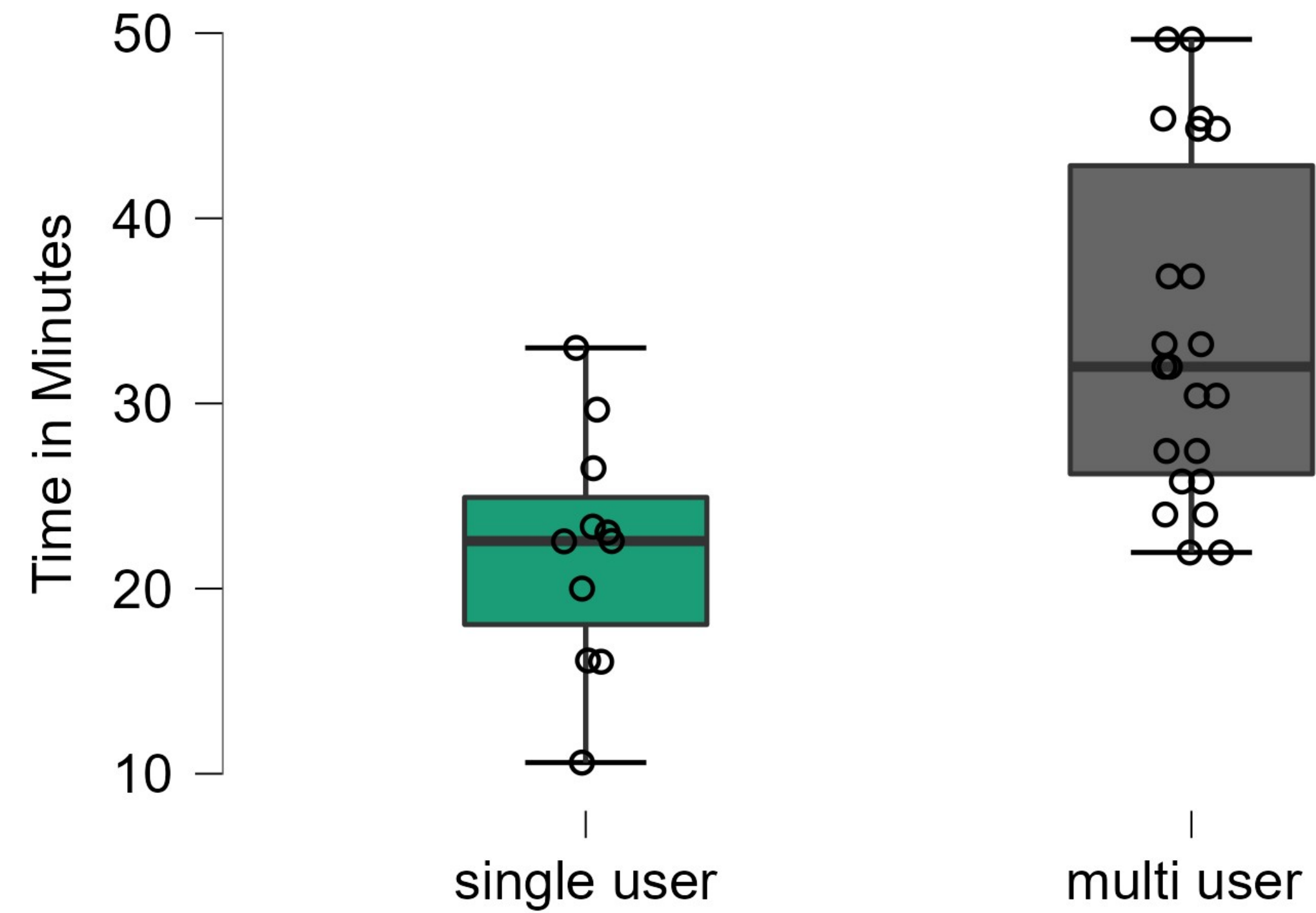


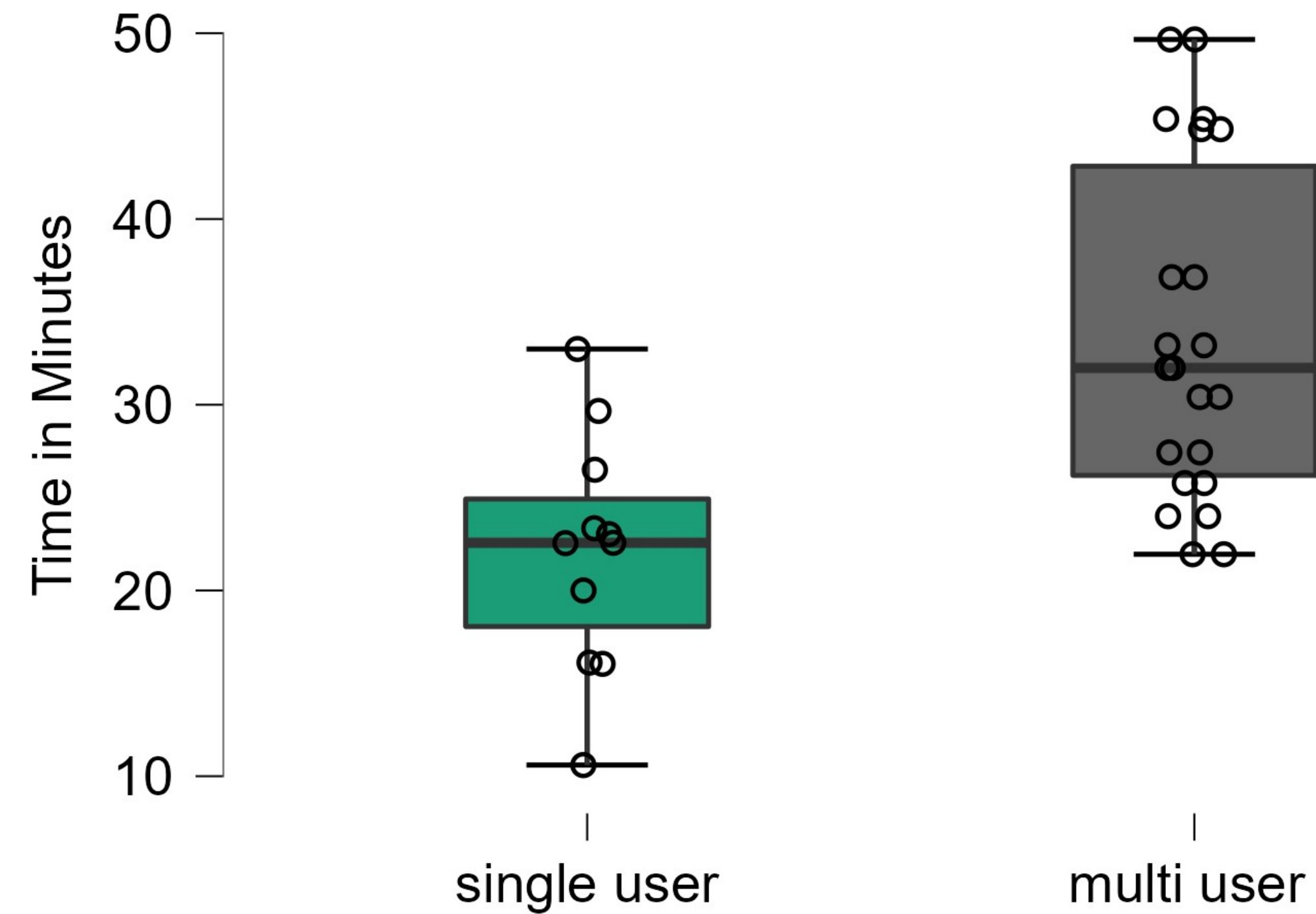
Results: Learning Progress



Effective anatomy learning in both groups (significant learning progress)

No advantage for multi-user

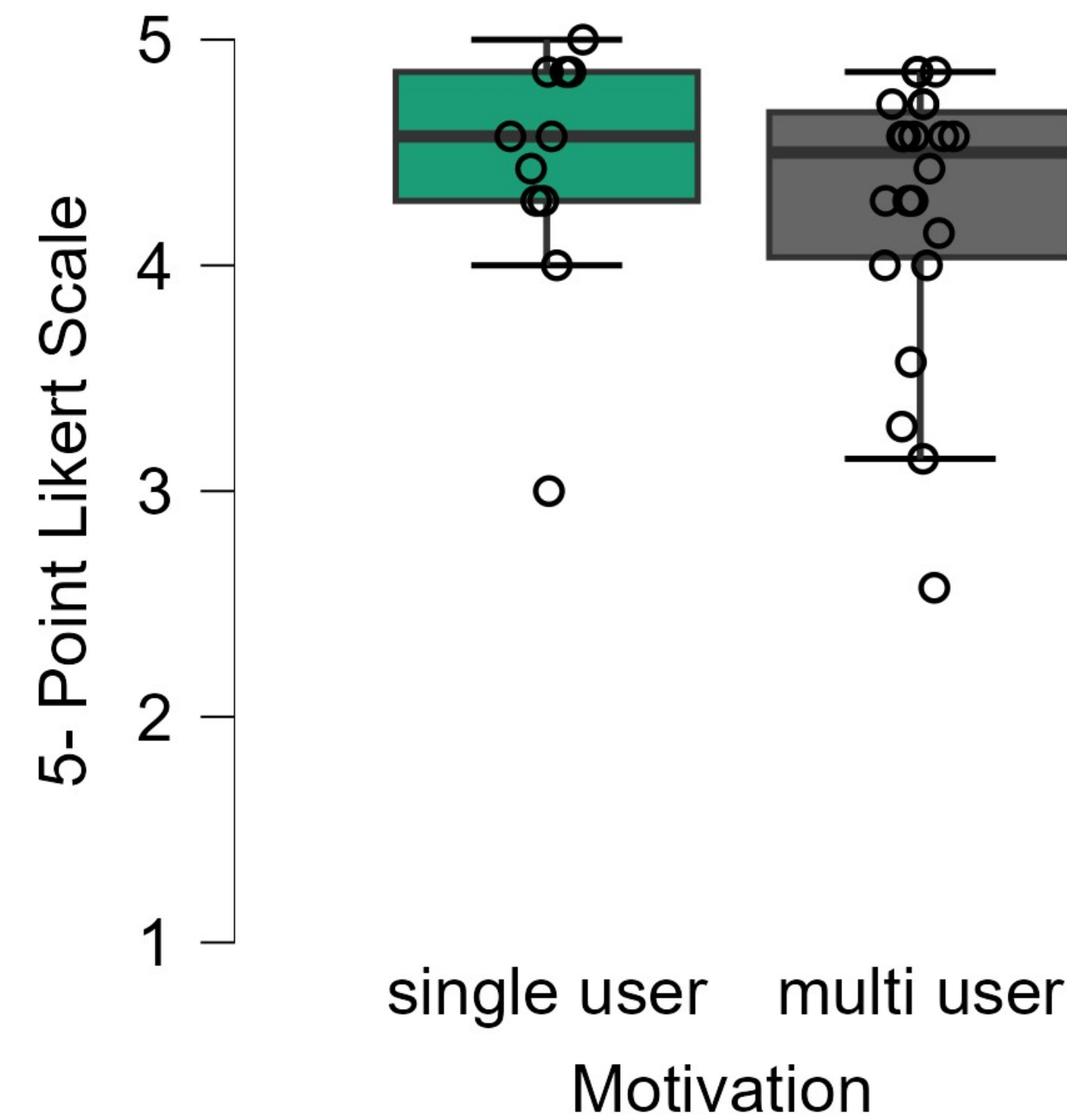




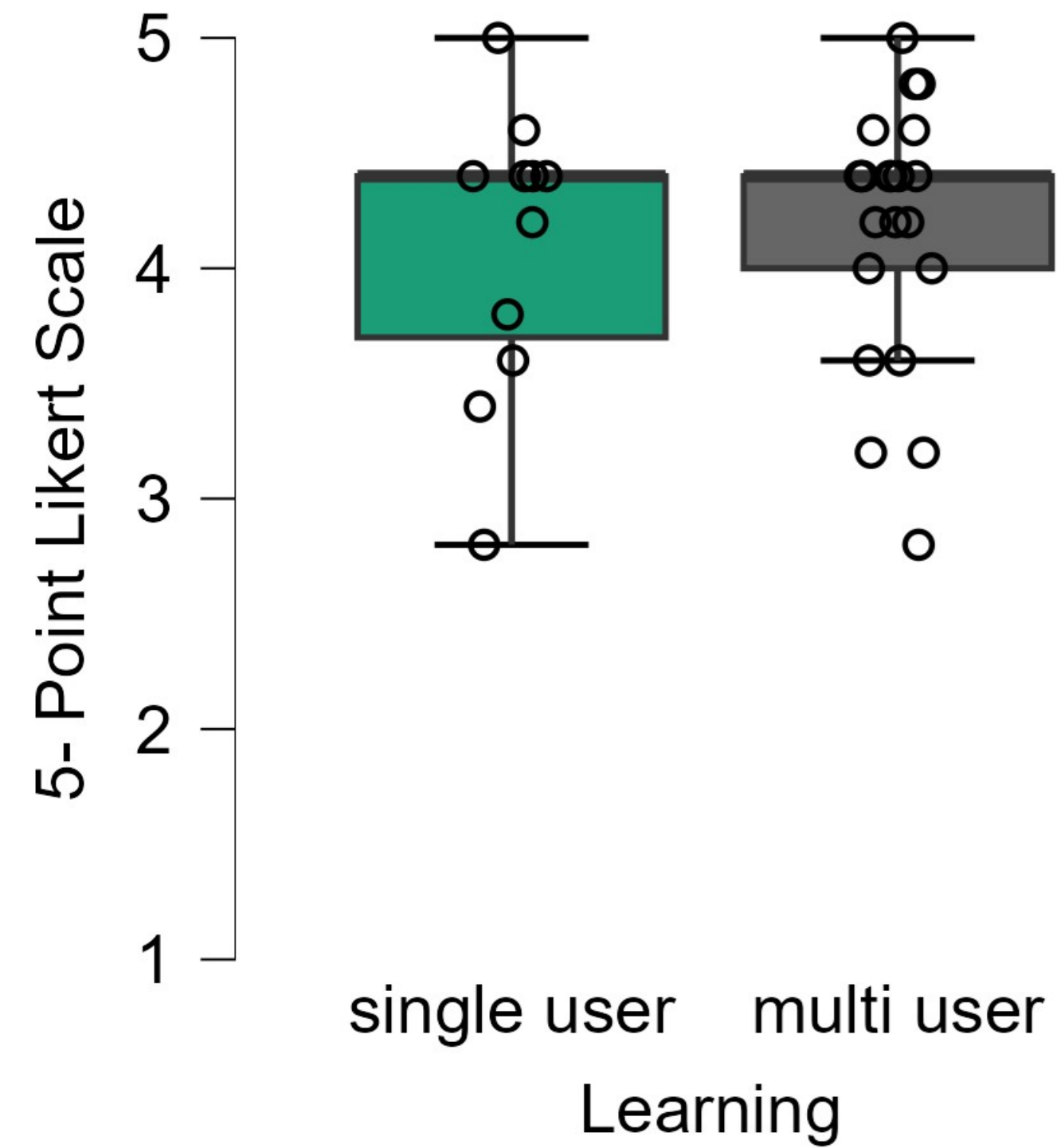
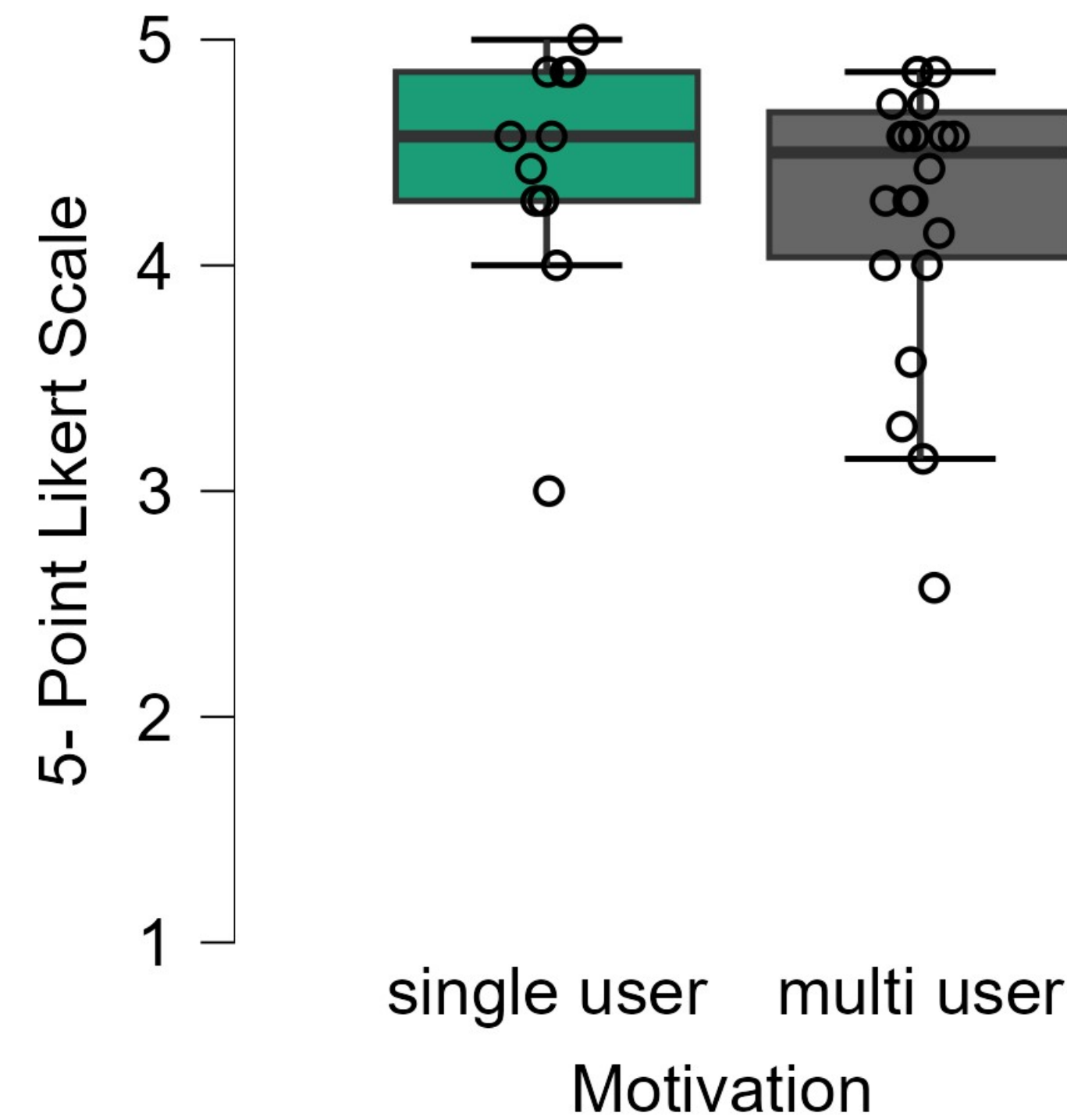
Multi-user group spent significantly more time in VR learning session

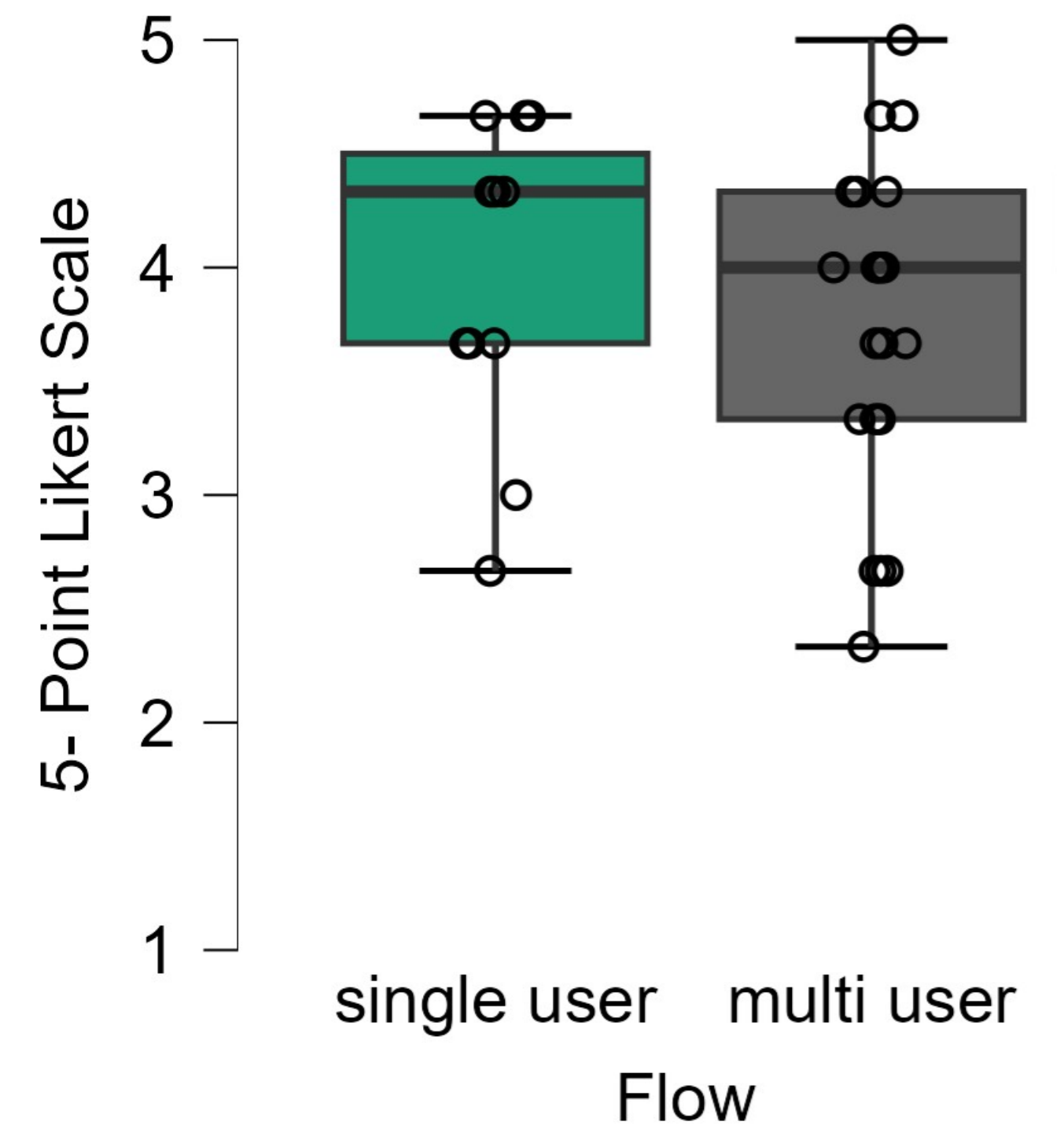
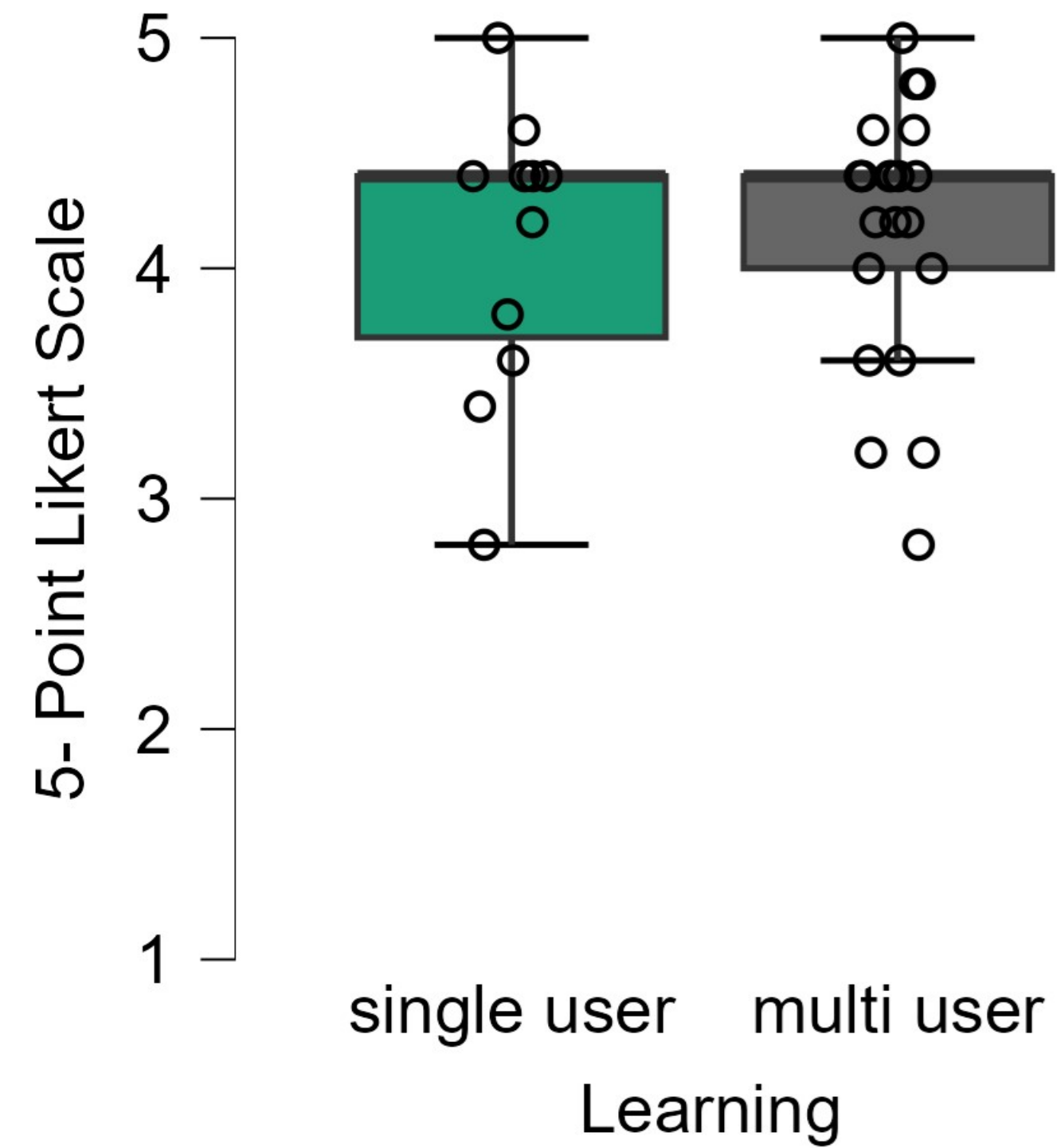
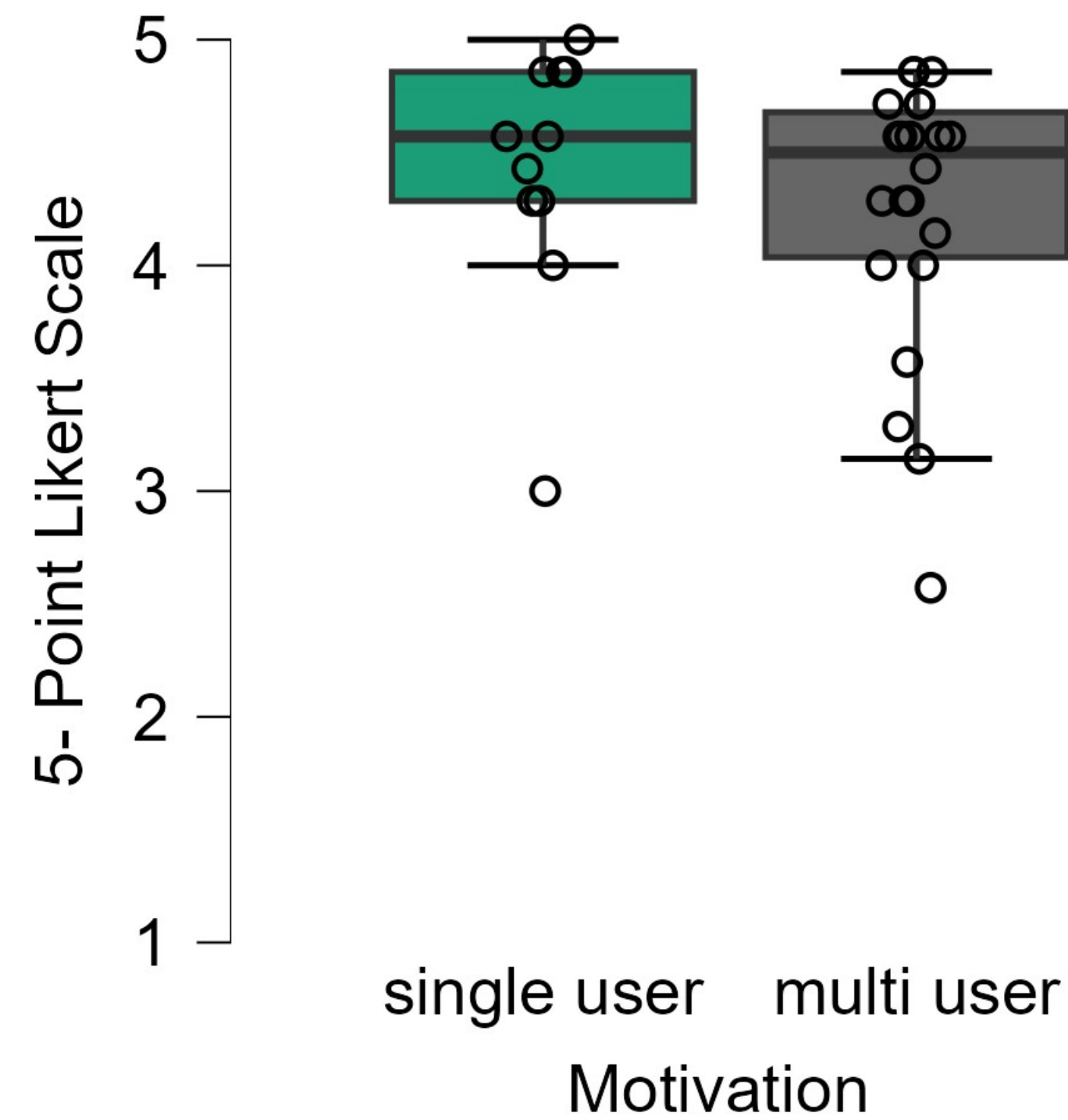
Results on Motivation

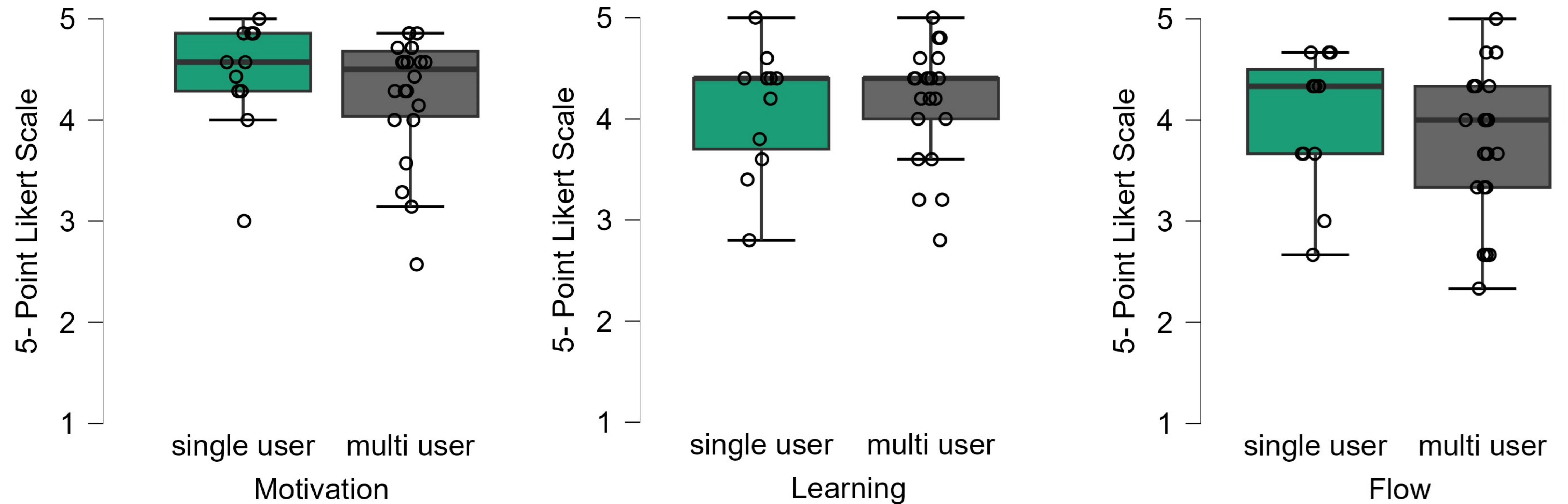
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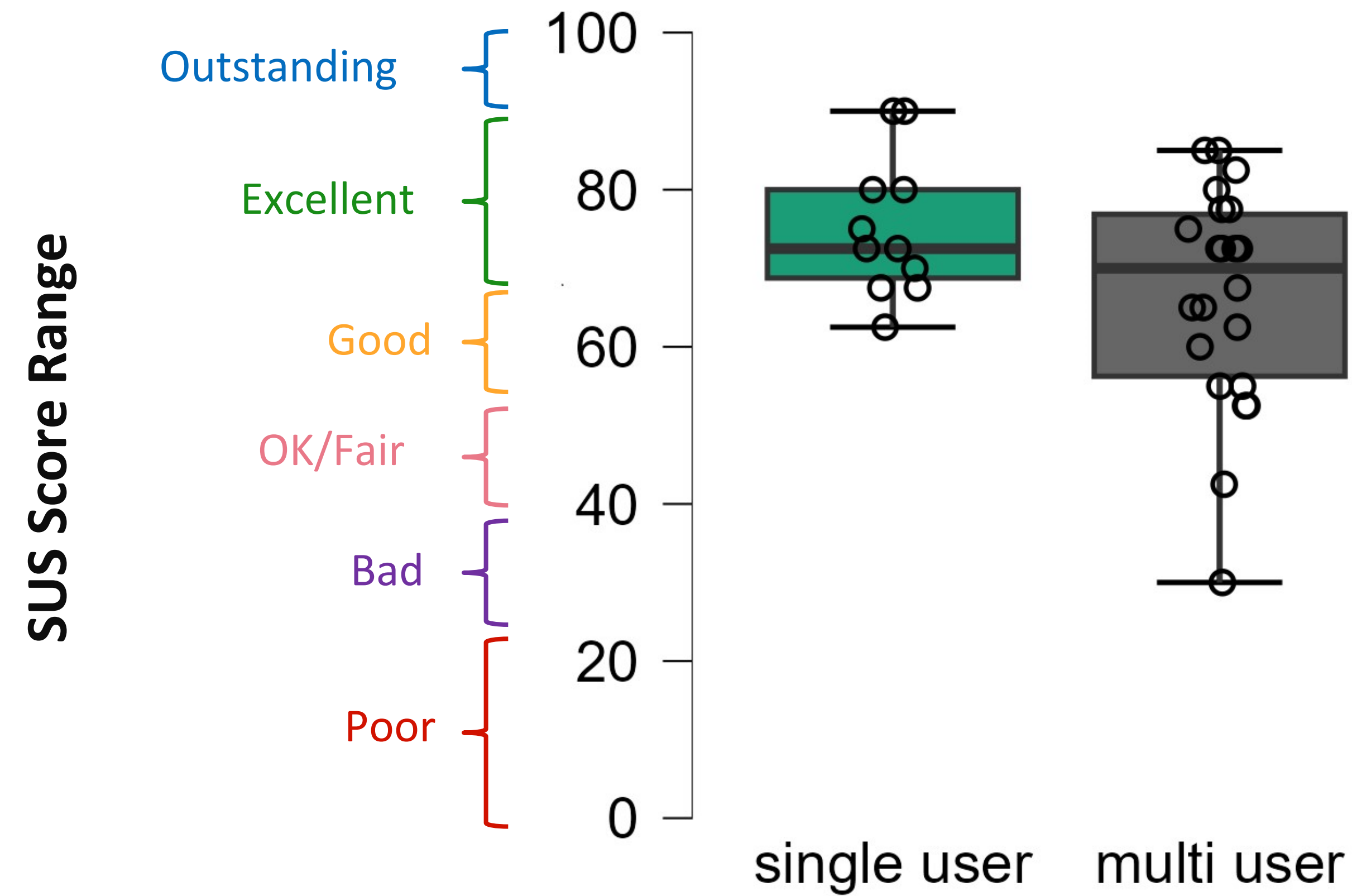






High motivation for both groups, no significant differences

Results on Usability



Usability high for single user
 (75.227), only moderate for multi
 user (66.364)

Limitation

- Number of participants was relatively small
 - ➔ Study's power may be limited
- Usability for multi user was only moderate
 - Disadvantage on learning success



- Study showed our Anatomy Atlas effective in enhancing knowledge for both user groups
- No advantage for collaborative learning in VR
- High motivation and interest in learning anatomy using VR

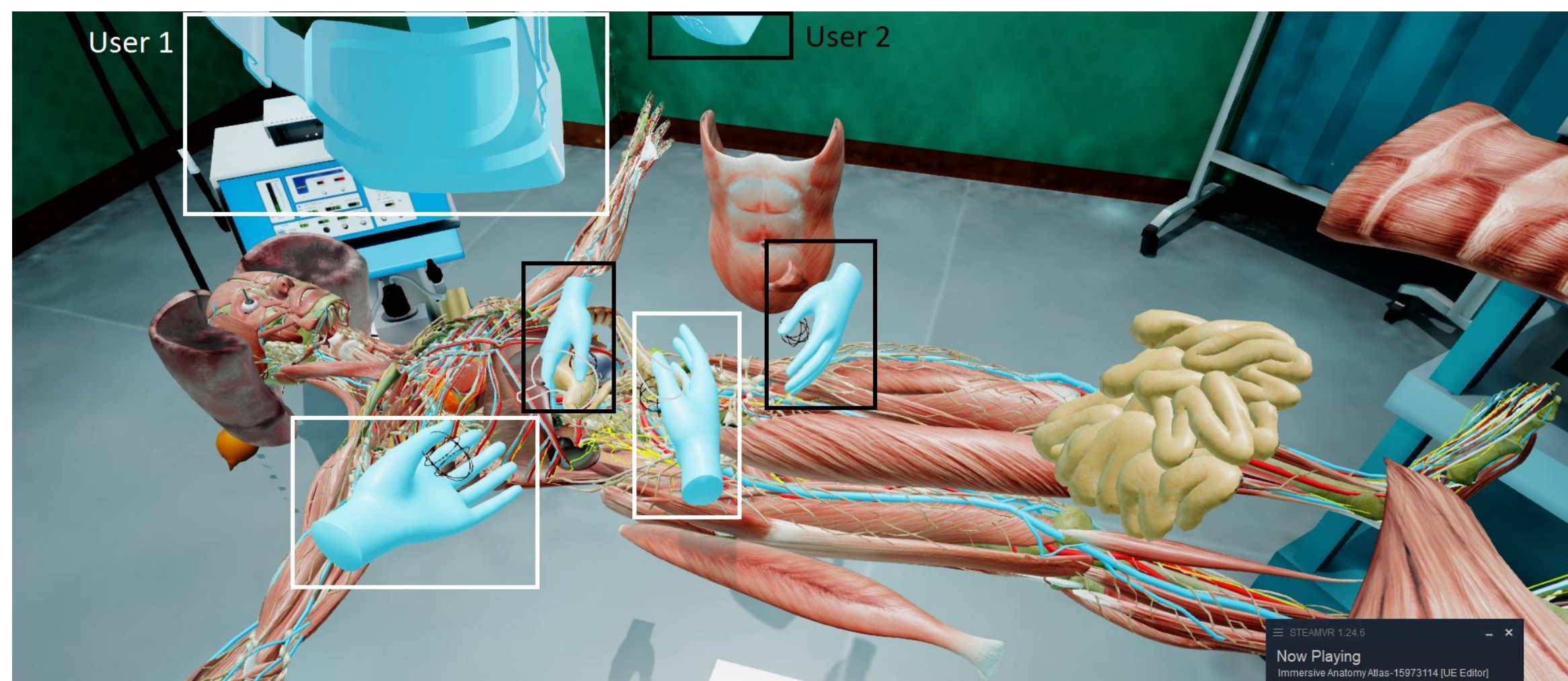
Future Work

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- Improve the multi-user experience/usability
- Explore effects of presence, cognitive load and high fidelity avatars
- Compare the effectiveness of collaborative VR anatomy atlas with traditional learning methods
- Compare VR setups with Mixed Reality setups for collaborative learning
- Examine larger groups and gender/age correlations in learning progress



Thank you for your attention! Questions?





References



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5. Haya (2023). User Study – Single User Gruppe