
Co-Located Vs. Distributed Teams: A Virtual Schoolhouse Experiment at Fleet Anti-Submarine Warfare Training Center

Helen R. Wright, Jason H. Wong, Anh B. Nguyen,
Lauren Ogren, Denise Fiorentino

Naval Undersea Warfare Center, Newport, RI

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Challenge:

Long distance training is everywhere.

It's coming to the Navy.



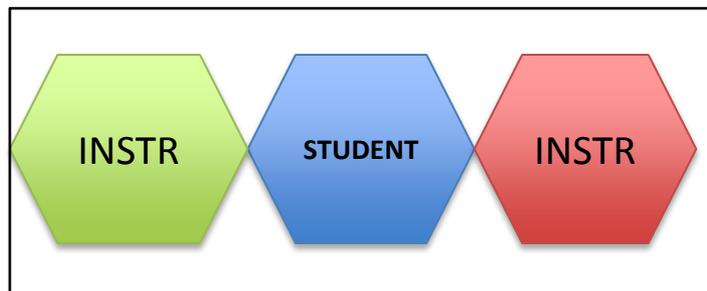
Are we ready or not?

Research Questions

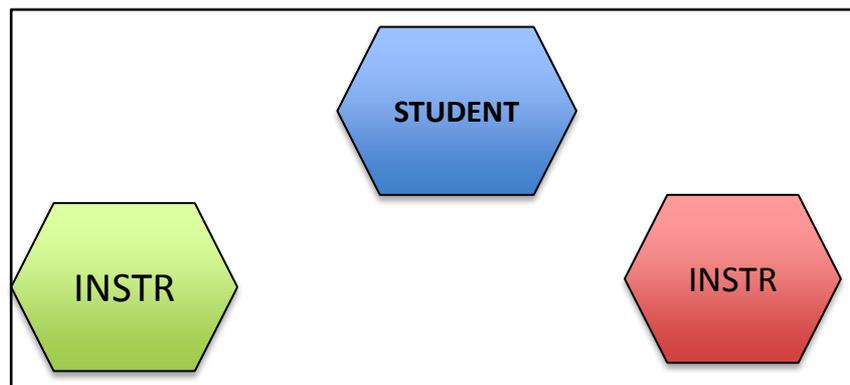
- Does working in a distributed virtual facility impact training effectiveness in terms of knowledge absorption, retention, and time to reach proficiency?
- Does distributing the team impact team dynamics?
 - Individual cognitive workload
 - Team-level cognitive workload
 - Flow
- Can we create an effective and efficient submarine team training environment using distance learning technologies?

Experimental Design

The control group was the original classroom setup and lab setup.



The experimental group studied in the Virtual classroom and lab.



The Task: FLEASWTRACEN

- **FLEASWTRACEN Sonobuoy training curriculum**
 - Classroom and four lab exercises
- **Active-duty FLEASWTRACEN students in the Navy pipeline.**
- **Key concepts designed into virtual exhibits in the Virtual Schoolhouse.**

Participants and Demographics

- Classes of twelve were split in half
 - six students in the traditional classroom
Control setting
 - six in the virtual, experimental setting.
- 29 males, 7 Females.
 - Seventeen subjects in the Virtual schoolhouse
 - Nineteen in the traditional classroom.

Instructor evaluation:

- Standard approved exams and practicals
- Administered by the instructors,
- Provided by the Navy as data to the researchers.
 - Final exams
 - Lab practicals

- Most common measure of workload is the **NASA Task Load Index (TLX)** (Hart & Staveland, 1988)
 - This is a self-report survey

Mental Demand

How mentally demanding was the task?



- Using Team TLX to also explore teamwork issues (Entin, Serfaty & Kerrigan, 1998)

<u>Individual Workload</u>
Mental Demand
Physical Demand
Temporal Demand
Performance
Effort
Frustration

Individual and team workload data was gathered at the end of each of the four lab sessions for NASA TLX and Team TLX.

Numerical weights for each factor were gathered at the end of the study to weight the workload ratings.

Flow

Traditional Flow

vs.

Game Flow

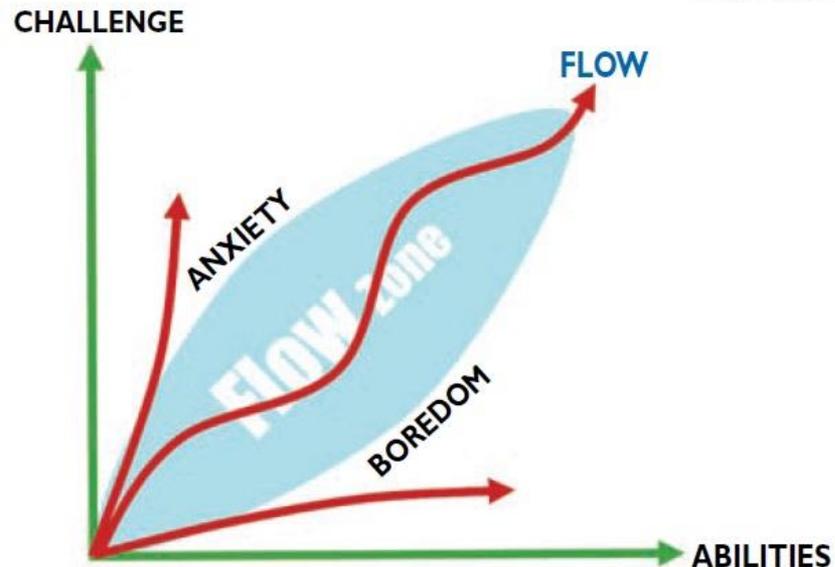
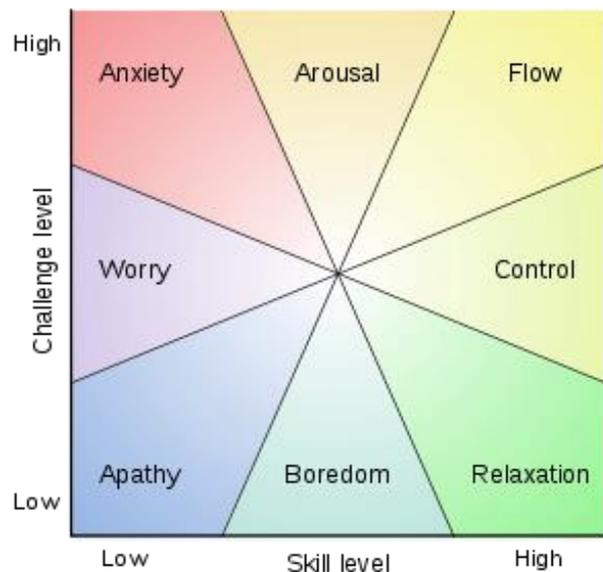
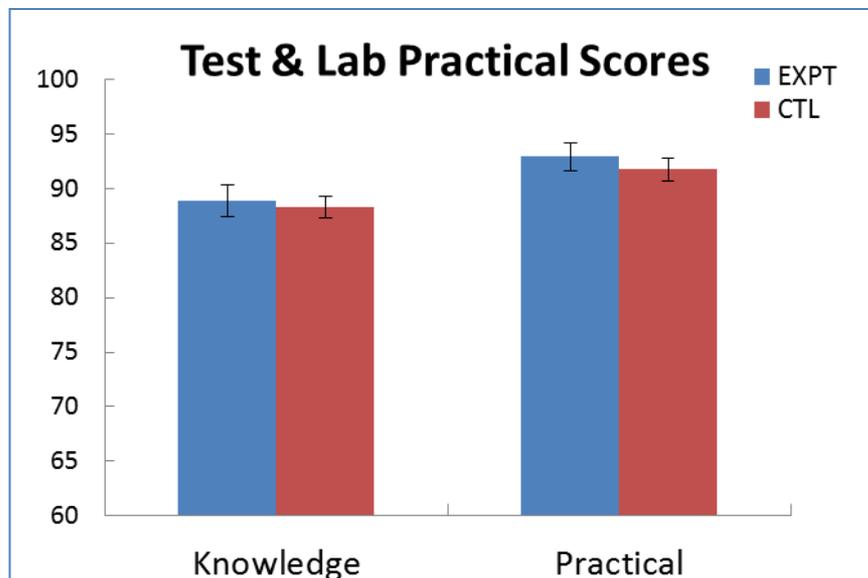


Figure 1. Flow Zone factors.

Streamlined commercial survey for its extreme brevity.
 (Owen Schaffer, Human Factors International)

How often did you know:

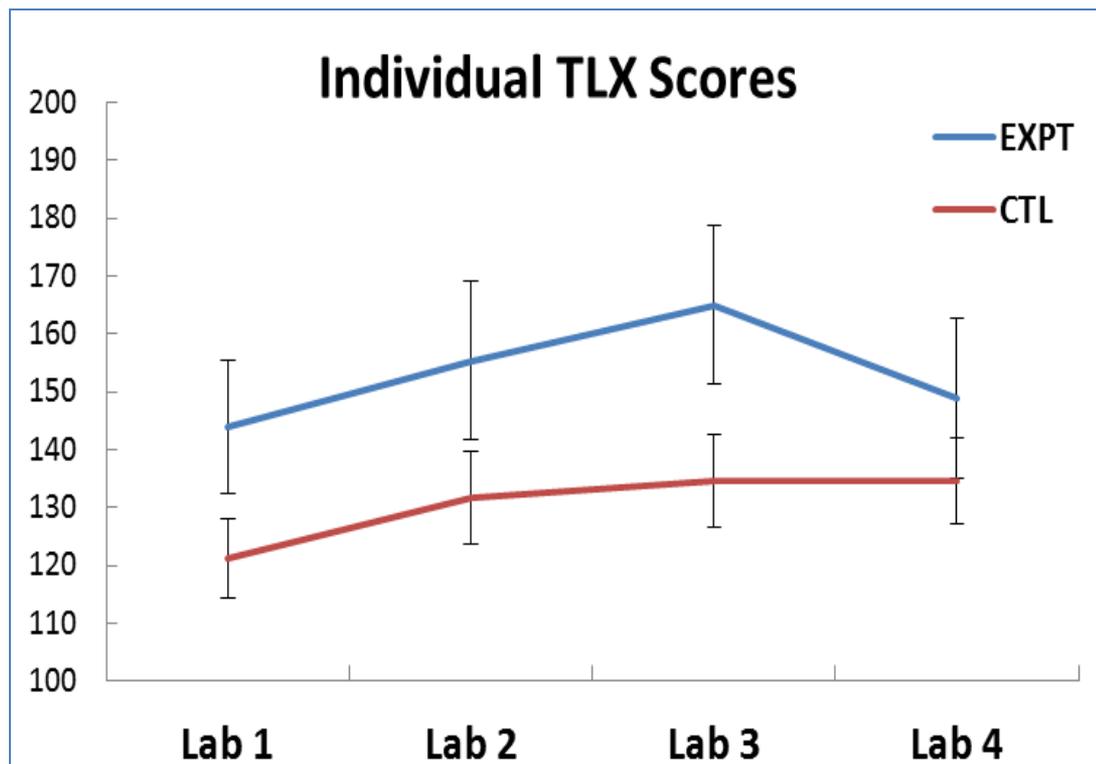
- 1 What to do next?
- 2 How to do what you were doing?
- 3 How well you were doing?
- 4 Where to go next?
- 5 How challenging did this activity feel?
- 6 How much did you feel able to overcome the challenges you faced?
- 7 FOCUS = 7 – (How distracted you were from what you were doing?)



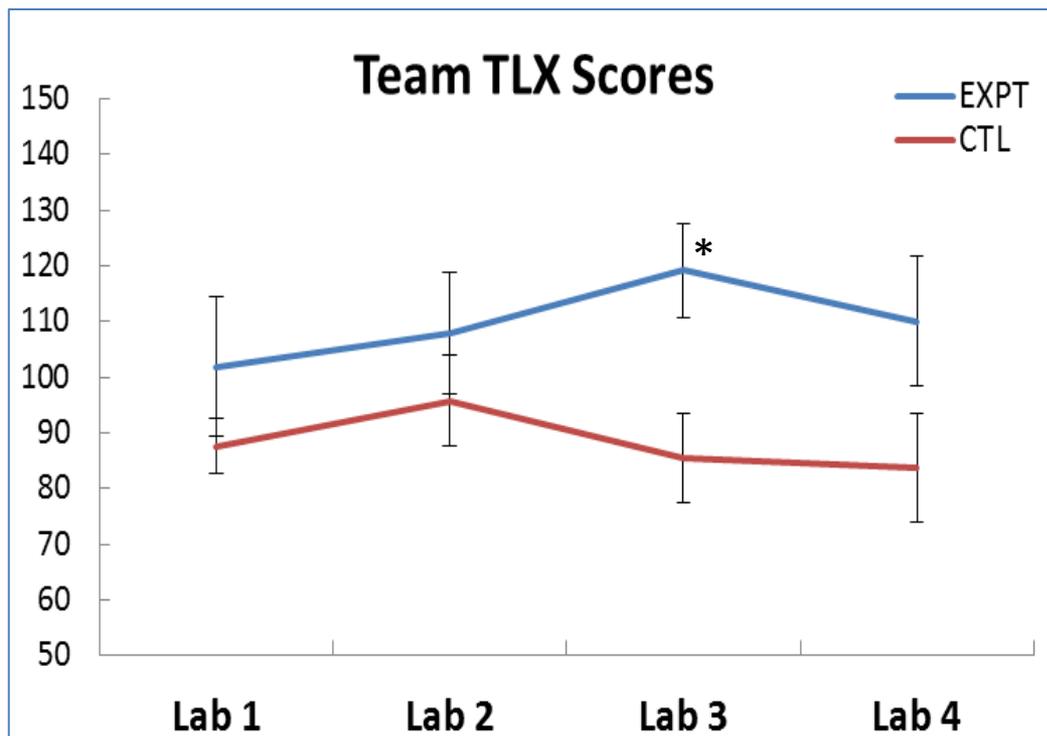
T-tests showed no significant difference between VSH and F2F groups for the classroom knowledge test and the lab practical test.

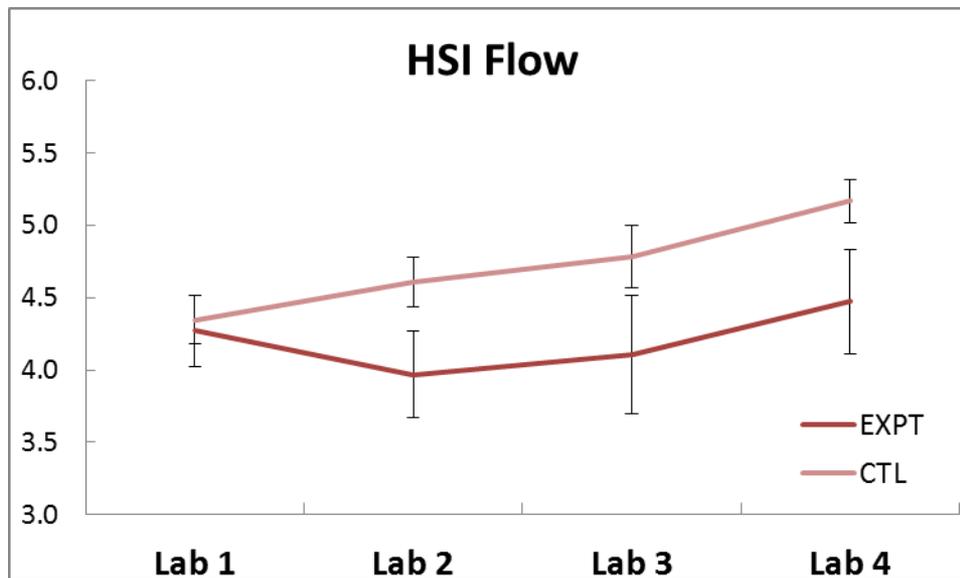
Categories are (1-6)
Mental Demand,
Physical Demand,
Temporal Demand,
Performance, Effort,
Frustration.

For averaged categories
over the four lab
periods: significant
difference did not occur
during the four labs.



Categories are (1-5)
 Communication demand,
 Monitoring Demand,
 Control Demand,
 Coordination Demand,
 and Leadership Demand.
 Averaged over the four lab
 periods, strong trends
 reach significance ($p =$
 0.007)* only during Lab 3.

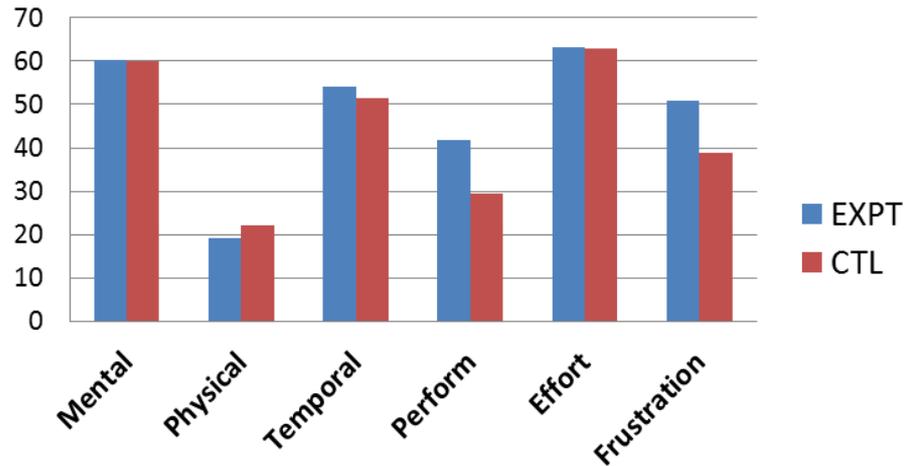




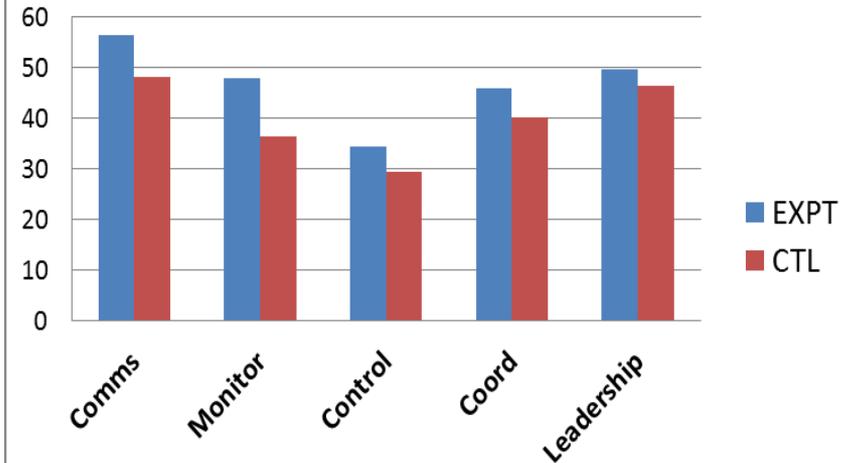
Flow. Flow calculations show the average of all the questions for each participant at each time, averaged across participants in each condition.

T-test: No significance from lab to lab (0.79, 0.06, 0.14, 0.08).

Raw NASA TLX by category

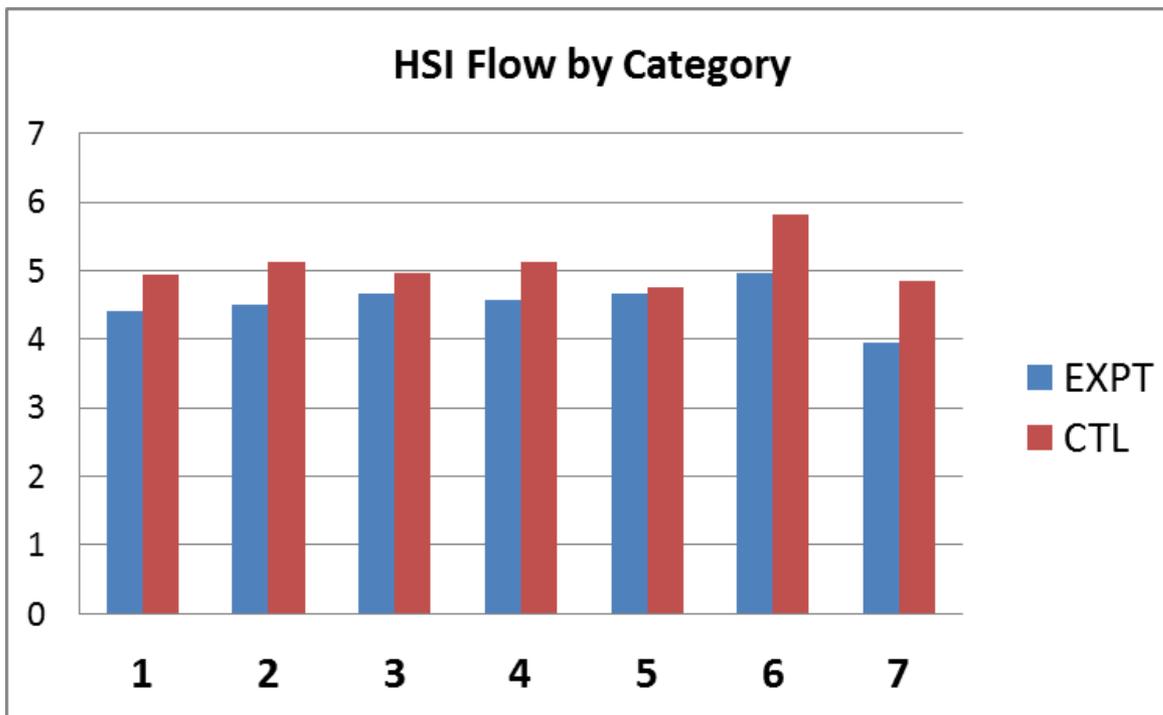


Raw Team TLX By category



- T-Tests of the Student's subjective self-reports by category across the labs are listed below:
- For Mental : $t(16) = 0.018$, $p = 0.986$
- For Physical : $t(16) = 0.935$, $p = 0.353$
- For Temporal : $t(16) = 0.612$, $p = 0.542$
- For Perform : $t(16) = 2.962$, $p = 0.004^*$
- For Effort : $t(16) = 0.081$, $p = 0.936$
- For Frustration : $t(16) = 2.401$, $p = 0.019^*$
- * $p < 0.05$, significant.

- T-Tests of the Students' subjective self-reports by category across the labs are listed below:
- For Comms : $t(16) = 1.707$, $p = 0.092$
- For Monitor : $t(16) = 2.491$, $p = 0.015^*$
- For Control : $t(16) = 1.271$, $p = 0.208$
- For Coord : $t(16) = 1.329$, $p = 0.188$
- For Leadership : $t(16) = 0.744$, $p = 0.459$
- * $p < 0.05$, significant.



Knew what to do next : $t(16)= 2.020 , p= 0.047^*$

Knew how to do it: : $t(16)= 2.474 , p= 0.016^*$

Knew how well I do it: : $t(16)= 1.341 , p= 0.184$

Knew where to go next: $t(16)= 2.107 , p= 0.038^*$

Was I challenged? $t(16)= 0.332 , p= 0.741$

Able to overcome challenges? $t(16)= 3.556 , p= 0.001^{**}$

Able to focus?: $t(16)= 3.207 , p= 0.002^{**}$

* $p < 0.05$.

** $p < 0.01$.

Results: What have we learned?

- Grades: the null hypothesis was not rejected.
- Workload:
 - Perception of Performance and perception of Frustration were significantly higher for Distributed teams.
 - The Monitoring category was significantly different between the two conditions.

Results (2): Flow

Not significantly different

- Knew how well I was doing
- How challenging did this activity feel?

Significant differences

- Knowing what to do next
- How to do it
- Where to go
- Feeling able to focus
- Feeling able to meet each challenge

For further research:

Does continued work in the virtual schoolhouse bring the average experimental flow state closer to the average control flow state?

Research Questions Review

- **Does working in a distributed virtual facility impact training effectiveness in terms of knowledge absorption, retention, and time to reach proficiency?**
 - Grades showed no difference.
- **Does distributing the team impact team dynamics?**
 - Individual cognitive workload
 - Team-level cognitive workload
 - Flow
- **Can we create an effective and efficient submarine team training environment using distance learning technologies?**
 - Still to be determined (Team size = 20 vice 3) but the indications from this study look good.

Thank you!

Questions?