Streamlined Technology-driven Orchestration

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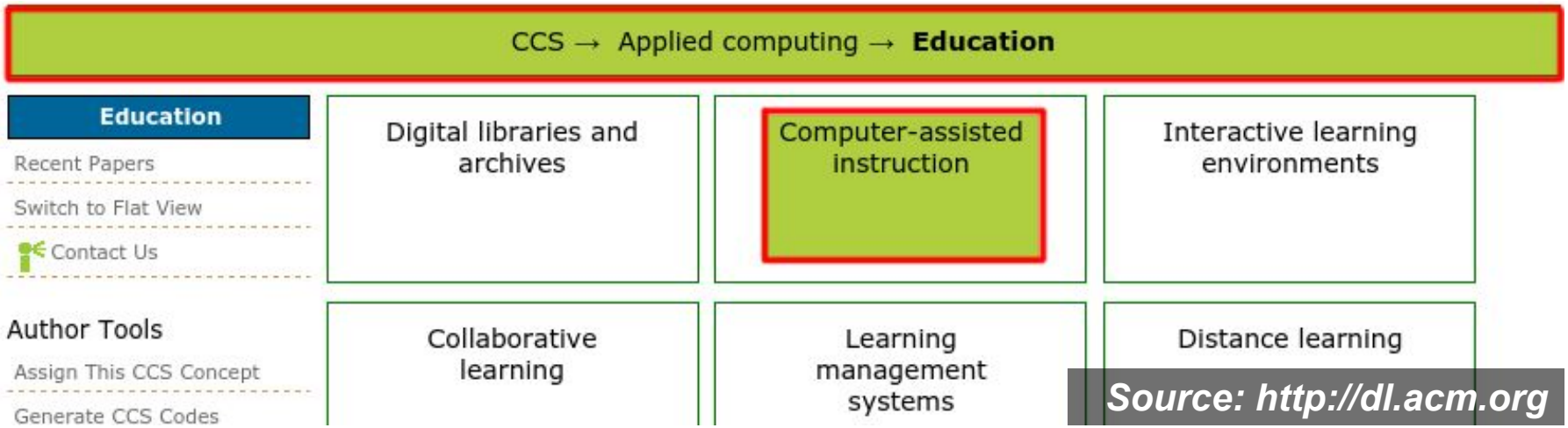
Introduction



We study technology-driven orchestration in order to understand the impact of organised orchestration of teaching.

- Study the use of an orchestration workbench for achieving streamlined technology-driven orchestration
- Demonstrate the successful use of approach

Motivation (1)

Formal learning spaces are inherently complex ecosystems—actors, activities, constraints.

Motivation (2)

Formal learning spaces can be turned into effective learning environments by supporting educators with orchestration.

Orchestration is challenging & ad hoc

Orchestration is *challenging* due to its multi-faceted nature

- Constraints such as time

Technology-driven orchestration is *ad hoc*—no standard way of orchestrating learning activities

- Analysis 1: Interviews
  - Expert reviews with eight UCT teaching staff
- Analysis 2: Observations
  - Classroom observations—END1020S; END1021F; STAT1100S
- Analysis 3: Archival records
  - UCT archived lecture recordings

Thesis statement

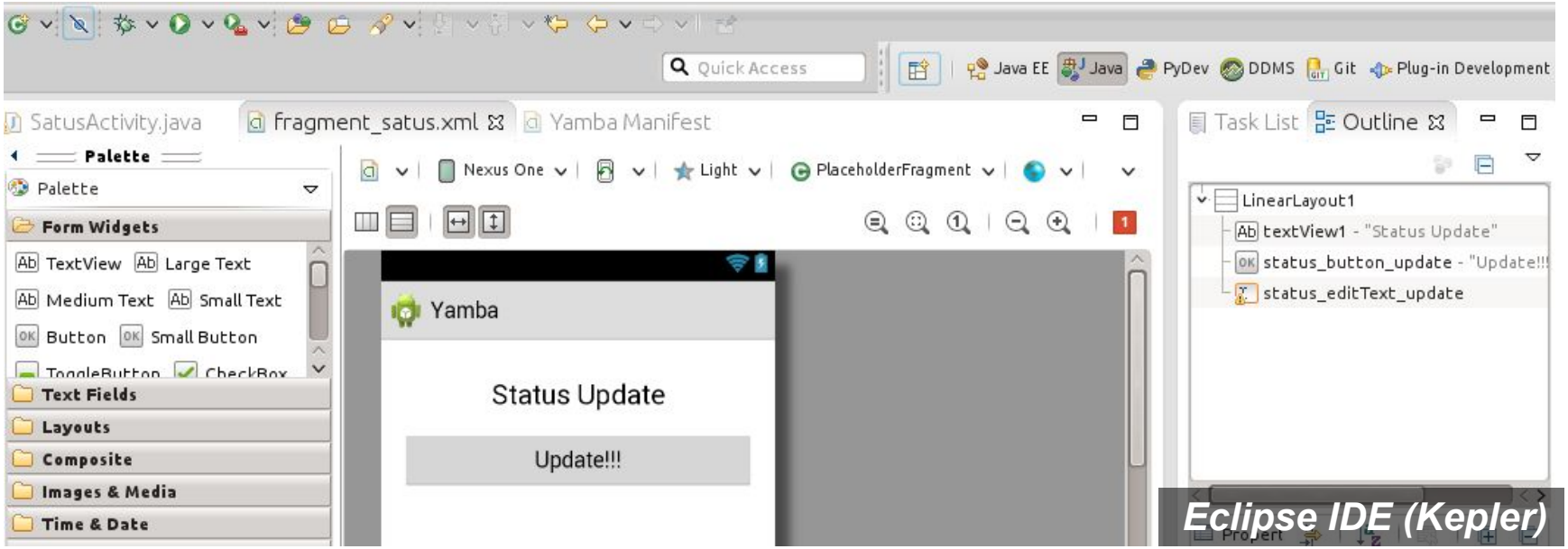
Streamlined orchestration—attainable through explicit organisation of learning activities using an orchestration workbench—could potentially make educators more effective.

Research questions

1) Does an orchestration workbench enable educators to become more effective?
2) What is the impact of an orchestration workbench on educators' teaching experience?

Inspiration

We draw inspiration from the success of explicit organisation of tasks and activities in other domains; for instance IDEs have proved successful in software development.



Streamlined orchestration

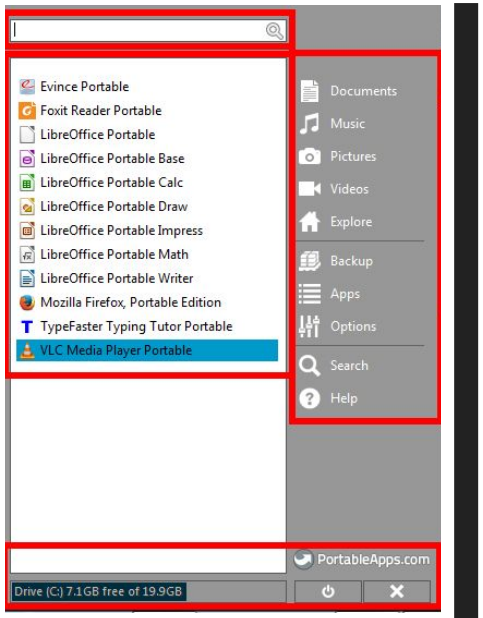
Using the concept of cross-plane integration [1] we view orchestration as a function of the scale of learning activities—individual, group or class—with respect to time.

- Enactment of learning activities
- Sequencing of activities
- Learning activity management
- Centralised access to tools and services

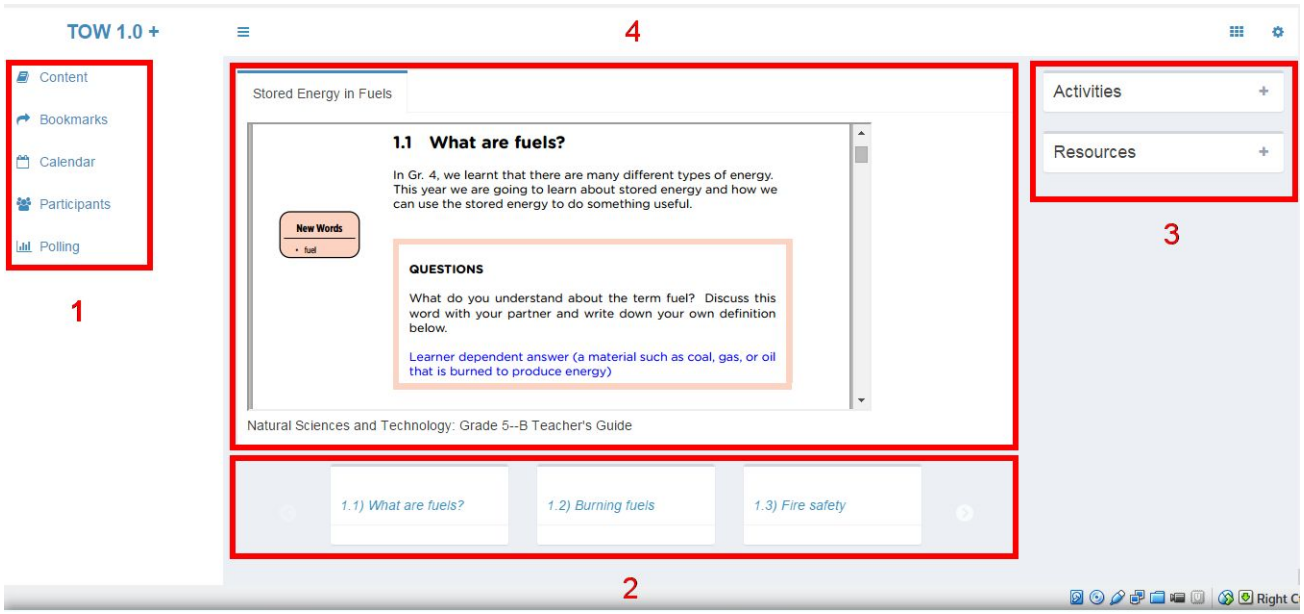
[1] Pierre Dillenbourg and Patrick Jermann. “Technology for classroom orchestration”. New Science of Learning. 525–552, 2011.

Study 1: Ad hoc vs. organised orchestration

- *PortableApps used to simulate ad hoc orchestration*
- *Workbench UI used to simulate organised orchestration*



PortableApps



Prototype Workbench

Study objectives

How does effectiveness & UX of organised orchestration, using an orchestration workbench, compare with ad hoc orchestration?

- H1: Workbench is more effective
- H2: Workbench results in positive user experience

RQ	***AH***	***Factor***	***Variable***	***Scale***	***Description***
RQ1	*H1*	*Task speed*	T_t	*Min*	*Task time*
		Success	*PQ*	*[-3 – 3]*	*AttrakDiff 2*
		Comfort	*HQ-I*	*[-3 – 3]*	*AttrakDiff 2*
RQ2	*H2*	*UX*	*HQ-*;ATT*	*[-3 – 3]*	*AttrakDiff 2*

Evaluation aspects

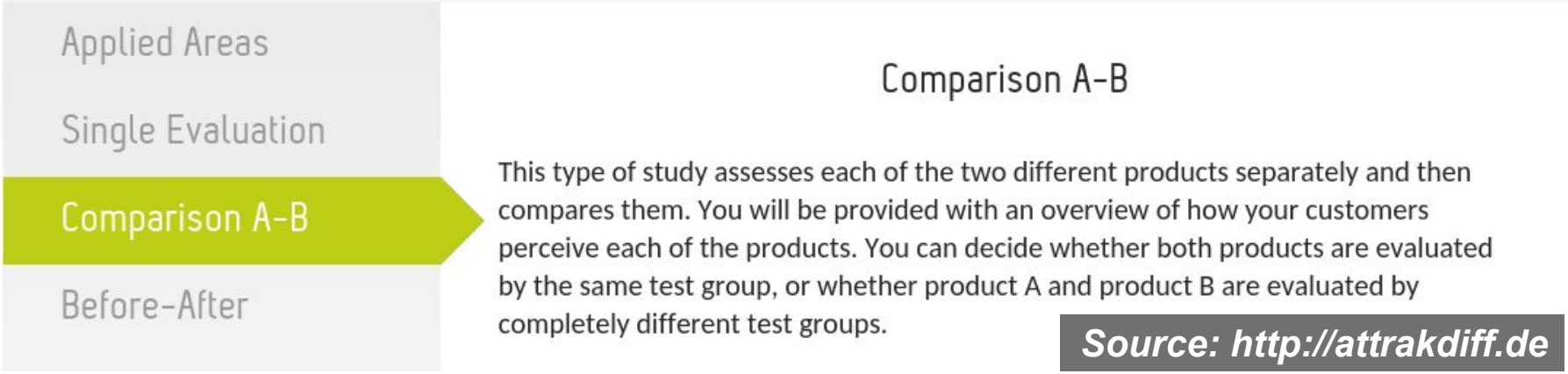
Effectiveness interpreted as follows:

- Learning activities orchestrated better, easier or faster
- Extent towards which orchestration goals were realised
- Participants’ level of comfort while orchestrating learning activities

User experience interpreted as participants' subjective views of orchestration technique's potential at meeting orchestration needs

Measurement instrument

AttrakDiff 2 used as primary measurement instrument



- Measures pragmatic quality (PQ), hedonic quality (HQ-I and HQ-S) and attractiveness quality (ATT) of interactive products
- Four dimensions associated with seven bipolar word-pairs—opposite adjectives

Study participants

At least 53 participants required for 'two-sample student t-test'

```
> pwr.t.test(d = 0.55, sig.level = 0.05, power = 0.80, type = c("two.sample"))
     Two-sample t test power calculation
              n = 52.87102
              d = 0.55
      sig.level = 0.05
          power = 0.8
    alternative = two.sided
NOTE: n is number in *each* group
```

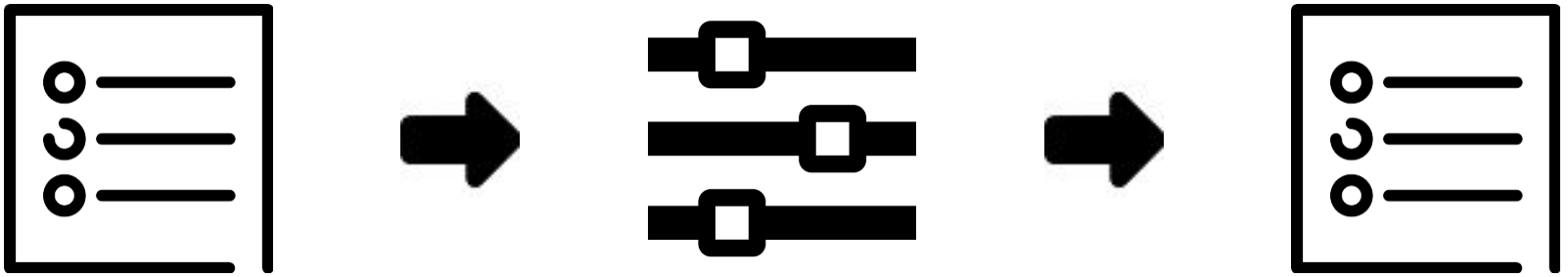
29 participants recruited with varying levels of study, experience teaching and experience using computers

Experimental variables & conditions

Pre-task activities

Orchestration tasks

Post-task activities



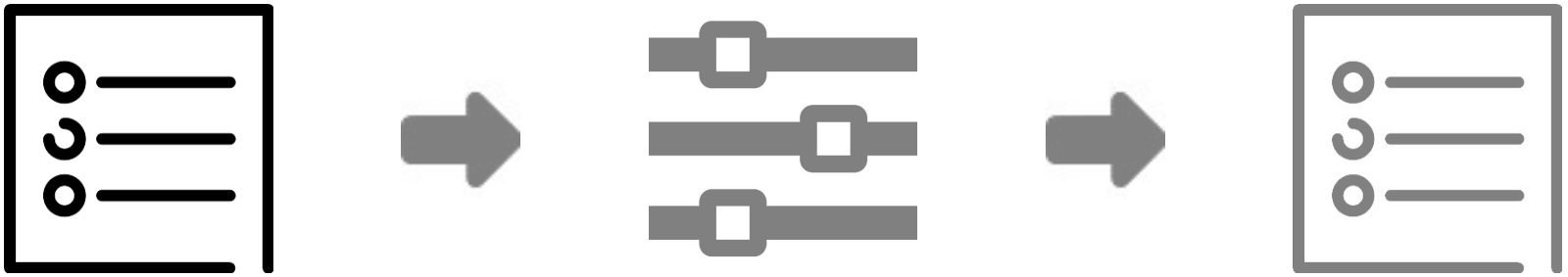
- Within-subject experiment involving two experimental conditions
  - IV: orchestration technique
  - DV: time on tasks; AttrakDiff 2 dimensions
  - CV: ISP levels; Teaching experience; Computing experience

Experimental procedure (1)

Pre-task activities

Orchestration tasks

Post-task activities



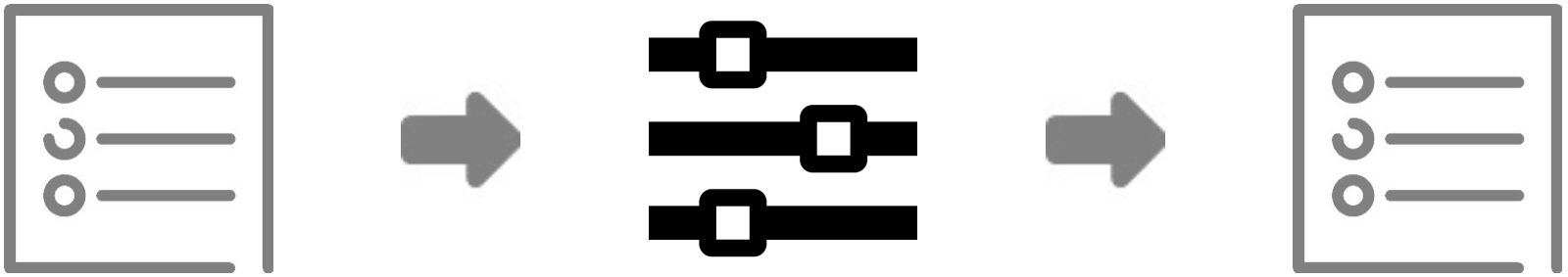
- Study briefing and consent
- Demographic information
  - ISP level—year of study
  - Teaching experience
  - Computing experience

Experimental procedure (2)

Pre-task activities

Orchestration tasks

Post-task activities



- Random experimental blocks

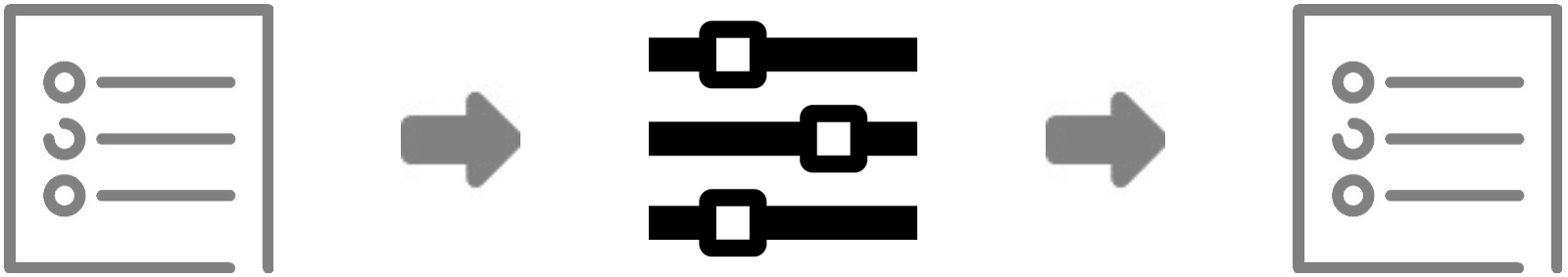
	Participants	***Approach 1***	***Approach 2***
Group 1	*15*	*Workbench*	*PortableApps*
Group 2	*14*	*PortableApps*	*Workbench*

Experimental procedure (3)

Pre-task activities

Orchestration tasks

Post-task activities



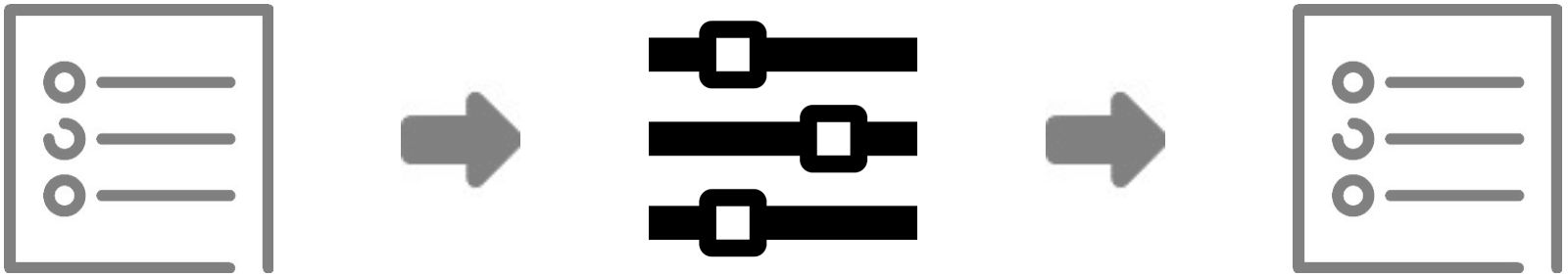
Source: http://thunderboltkids.co.za

Experimental procedure (3)

Pre-task activities

Orchestration tasks

Post-task activities



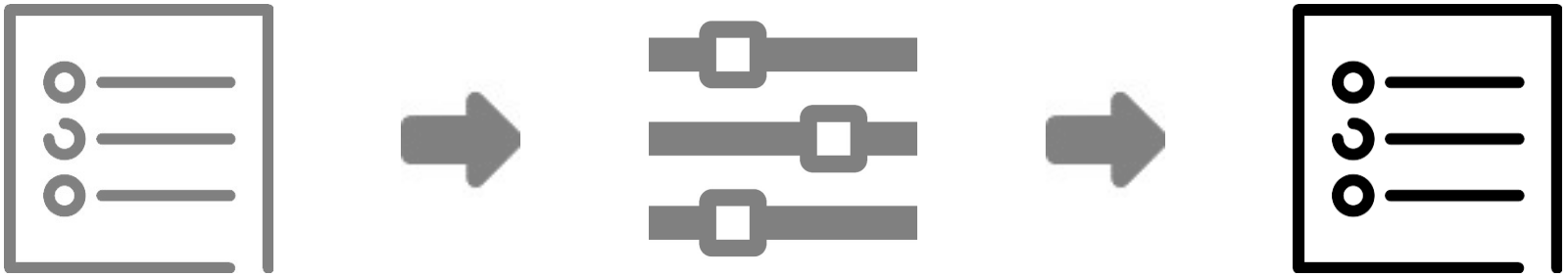
- Guided orchestration
  - Directed sequencing of learning activities
- Learning scenario
  - Lesson 1.1—"*What are fuels?*"
  - (1) Lesson -> (2) Video -> (3) Activity -> (4) Investigation

Experimental procedure (4)

Pre-task activities

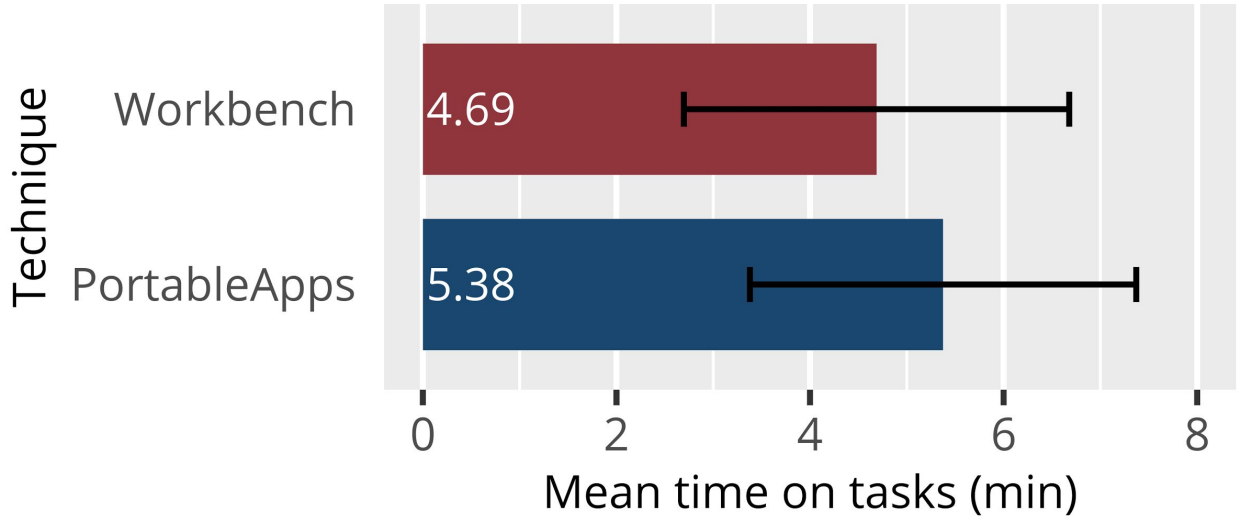
Orchestration tasks

Post-task activities



- AttrakDiff 2 ‘Comparison A–B’
  - Approaches—PortableApps & Workbench UI
  - (1) Approach #1 -> (2) Approach #2
- Debriefing
  - Study summary

Results 1: Time on tasks (1)

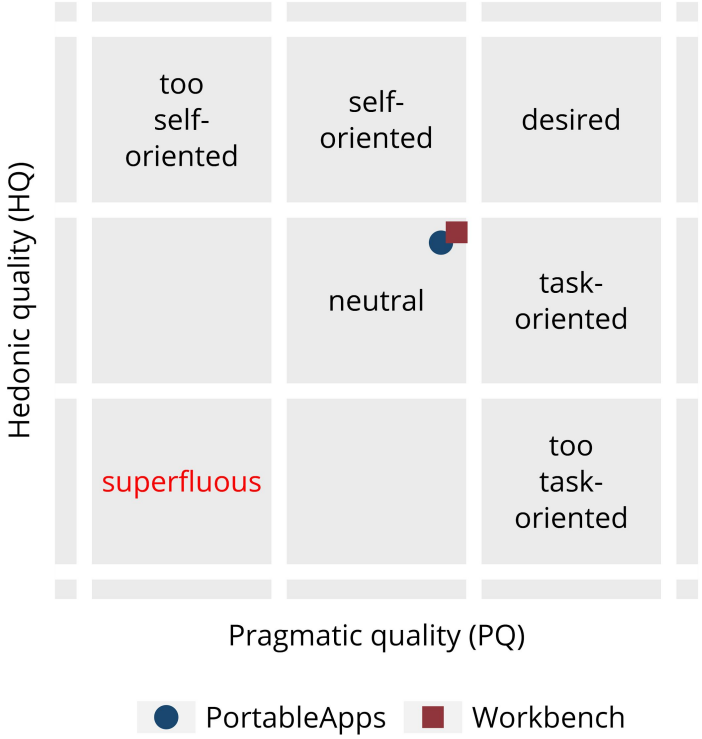


- On average, orchestration of learning activities was 14.7% faster using workbench

Results 2: AttrakDiff 2 (1)

AttrakDiff 2 portfolio-presentation

- Both orchestration approaches fall within the same character region
- Workbench approach falls closer to desired character region

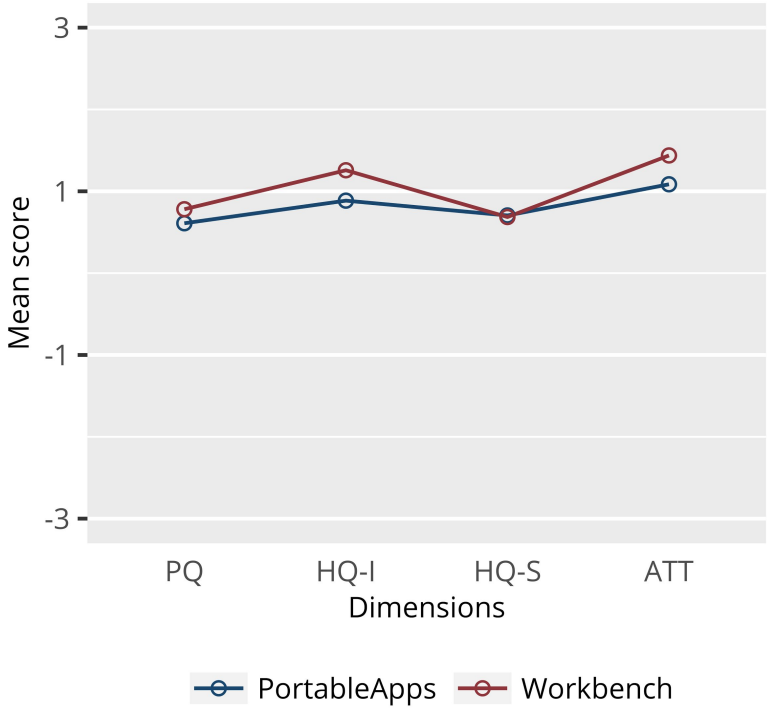


Results 2: AttrakDiff 2 (2)

AttrakDiff 2 dimension means

- PQ; HQ-I; ATT
  - Mean score higher for workbench on average
- HQ-S
  - Mean score slightly higher for PortableApps on average

Further analysis of dimension means done using word-pairs



Analysis 1: Counterbalancing

Potential impact of approach complexity during transition

	Workbench	***PortableApps***	***Remarks***
Group 1	*5.14 (1.86)*	*7.00 (1.73)*	*Workbench 36.2% faster*
Group 2	*4.33 (2.12)*	*4.11 (1.05)*	*PortableApps 5.4% faster*

Similar trends as overall results for dimension means

	Approach	***PQ***	***HQ-I***	***HQ-S***	***ATT***
Group 1	*Workbench*	*0.33 (1.26)*	*0.45 (1.54)*	*0.36 (0.67)*	*0.33 (0.71)*
	PortableApps	*0.19 (1.09)*	*0.17 (1.25)*	*0.57 (0.97)*	*0.17 (0.93)*
Group 2	*Workbench*	*1.59 (1.48)*	*2.10 (0.77)*	*0.90 (0.72)*	*0.95 (0.60)*
	PortableApps	*0.89 (1.44)*	*1.19 (0.93)*	*1.71 (0.92)*	*1.37 (1.11)*

Analysis 2: User comments

Participants' comments

"If I were to do this with my learners I would definitely do approach 1" —Group 1

"Having to use approach 2 with my learners would take longer than doing the first one" —Group 1

"I liked it more than the first approach. This was really good and creative, easy to access your resources and activities" —Group 2

"The second activity was harder for me to do." —Group 1

Study findings

Workbench approach potentially more effectiveness

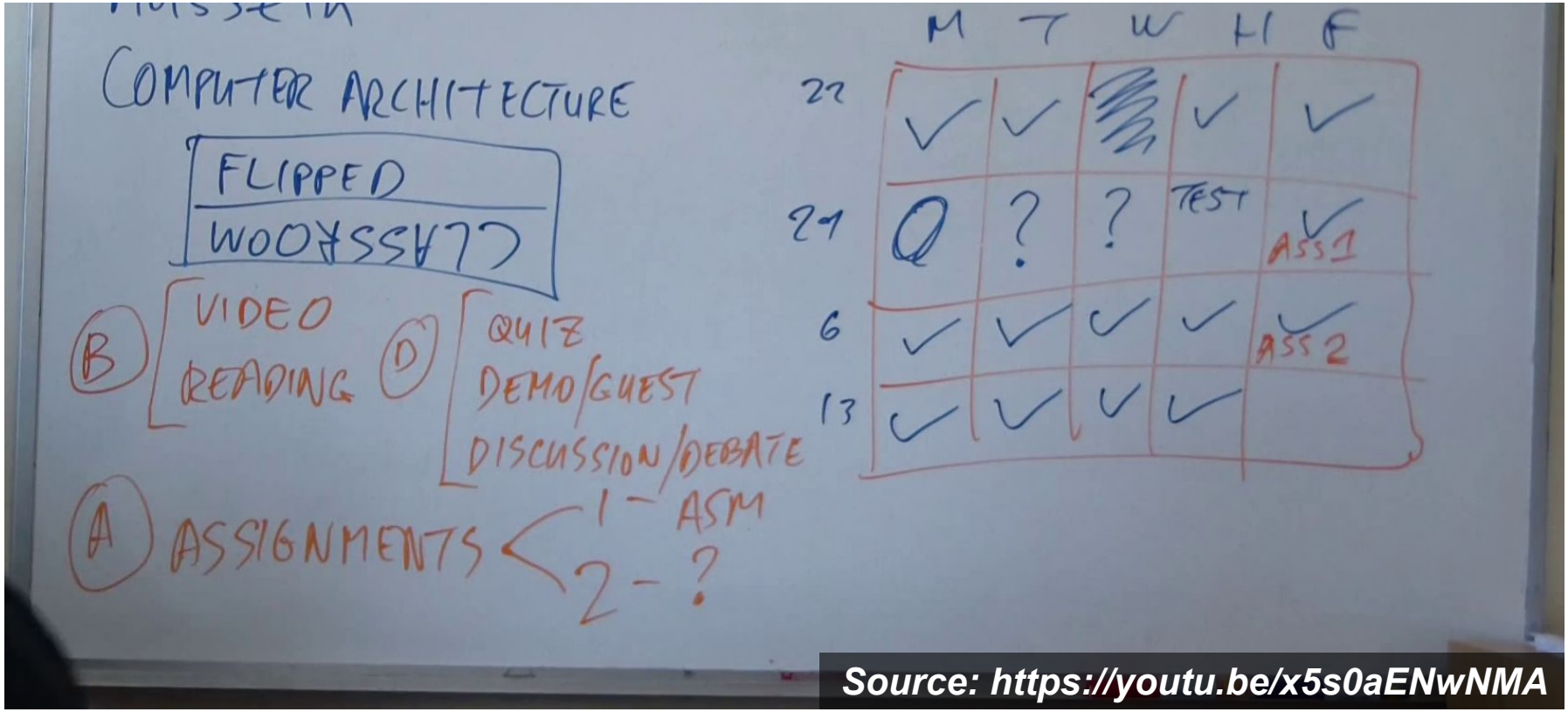
- Learning activities orchestrated faster using workbench
- Perceived success more pronounced with workbench

Positive user experience for workbench approach

- Workbench had higher mean score for HQ-I and ATT dimensions

Study 2: Orchestrating a flipped class

CSC2002S—Computer Architecture flipped class outline structure



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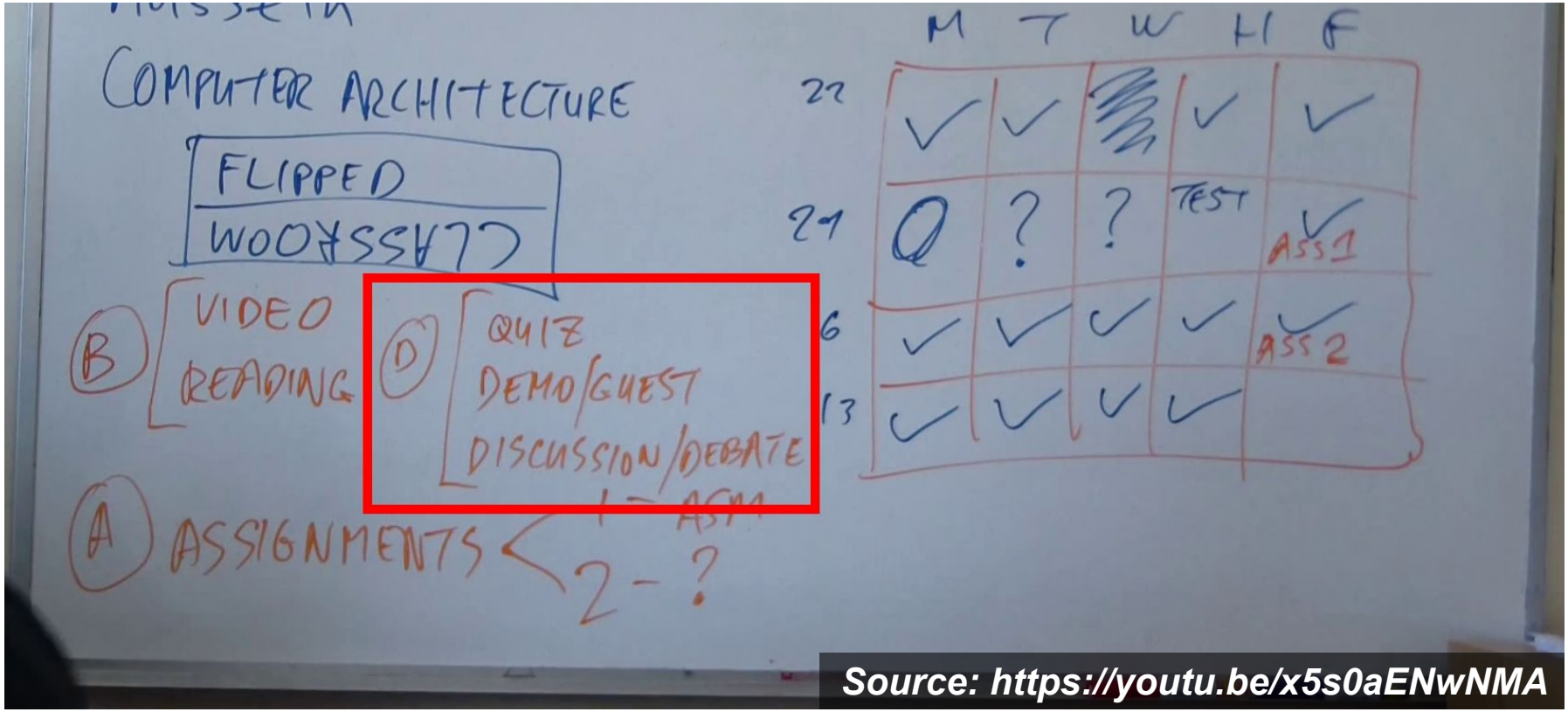


Study objectives (1)

Study aimed at assessing the feasible and potential of organised orchestration in authentic educational settings.

- To what extent does workbench approach aid orchestration?
- What is the potential impact of workbench approach on learning?

RQ	***Object***	***Instrument***	***Scale***	***Description***
RQ1	*Educator*	*Video segments*	*Min*	*App usage*
	Educator	*Interviews*	*[-3 – 3]*	*Interviews*
RQ2	*Learners*	*Survey*	*[-3 – 3]*	*Questionnaire*

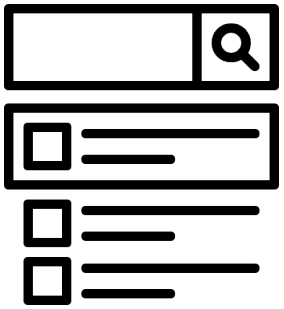
Study objectives (2)

Workbench UI implemented to orchestrate core activities

Source: http://media.uct.ac.za

Evaluation procedure (1)

(1)
Usage



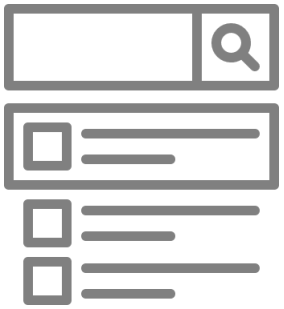
(2)
Educator

(3)
Learners

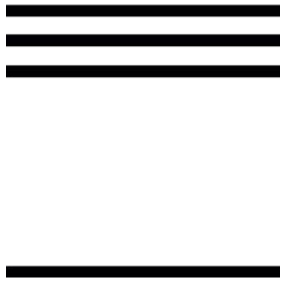
- Usage pattern analysis involved video analysis of lecture recordings—”Presentation View”
  - Opencast Matterhorn segmentation analysis
  - 11 sessions analysed
  - Orchestration tools and usage frequencies noted

Evaluation procedure (2)

(1)
Usage



(2)
Educator

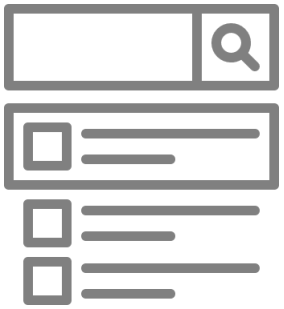


(3)
Learners

- Educator interaction with workbench tool was evaluated two-fold
  - Informal interview sessions
  - Direct observations of tool use

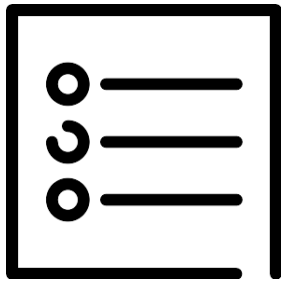
Evaluation procedure (3)

(1) Usage



(2) Educator

(3) Learners



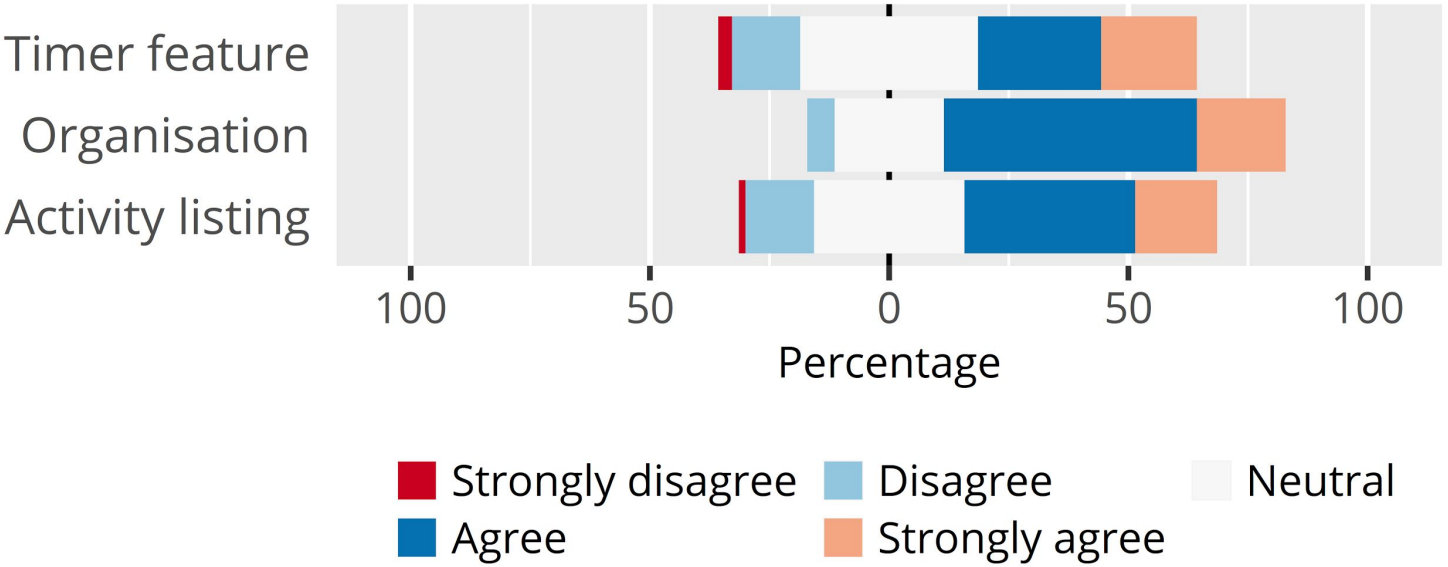
- Learner survey conducted on last day of class to elicit subjective experience
  - 71 participants recruited
  - Static sequencing, learning activity organisation, and specific prototype features

Analysis 1: Tool usage pattern

- Nine orchestration tools used during duration of course
  - Most tools used to render content
  - Specialised tools once-off tasks
- On average prototype used most of the time
  - Used 66.72% on average
  - Switching occurred an average of two times with noticeable time during switchover

Tool	Freq.	Duration
Workbench	10	00:30:31
VideoGlide	8	00:07:56
Firefox	1	00:21:29
Impress	1	00:38:26
Evince	1	00:00:50
QtSpim	1	00:12:47
Robotic Arm	1	00:01:24
TextEditor	1	00:02:07
VirtualBox	1	00:00:58

Analysis 2: Learner experience



- Tool perceived to have helped organise activities
- Static sequencing (activity listing) found helpful
- Timer feature perceived useful

Study findings

Feasibility of organised orchestration

- Facilitated neutral flow of activities
- Results from learner survey indicate tool was impact neutral

Potential to facilitate improved learning outcomes

- Learner survey suggests orchestration workbench has the potential to positively impact learning experience

Future directions

1) Experiment: Guided orchestration for peer learning
    - Authentic learning environment
    - Measuring effectiveness, orchestration load and user experience
2) Experiment: Dynamic enactment of learning activities
    - Pre-session management
    - Measuring orchestration load and user experience
3) Analysis: Comprehensive analysis of UCT lecture recordings
    - Support for ad hoc orchestration claim
4) Experiment: Sharable orchestration OERs
    - Reusable and sharable orchestration appliances

Bibliography

[1] Jeremy Roschelle et al. "*Classroom Orchestration: Synthesis*". Computers & Education, 6a9:523–526, 2013.

[2] Pierre Dillenbourg. "*Design for Classroom Orchestration*". Computers & Education, 69:485–492, 2013.

[3] Pierre Dillenbourg and Patrick Jermann. "*Technology for classroom orchestration". New Science of Learning*. 525–552, 2011.

[4] Luis P. Prieto et al. "*Orchestrating technology enhanced learning: a literature review and a conceptual framework*". International Journal of Technology Enhanced Learning, 3(6):583, 2011.

Streamlined Technology-driven Orchestration

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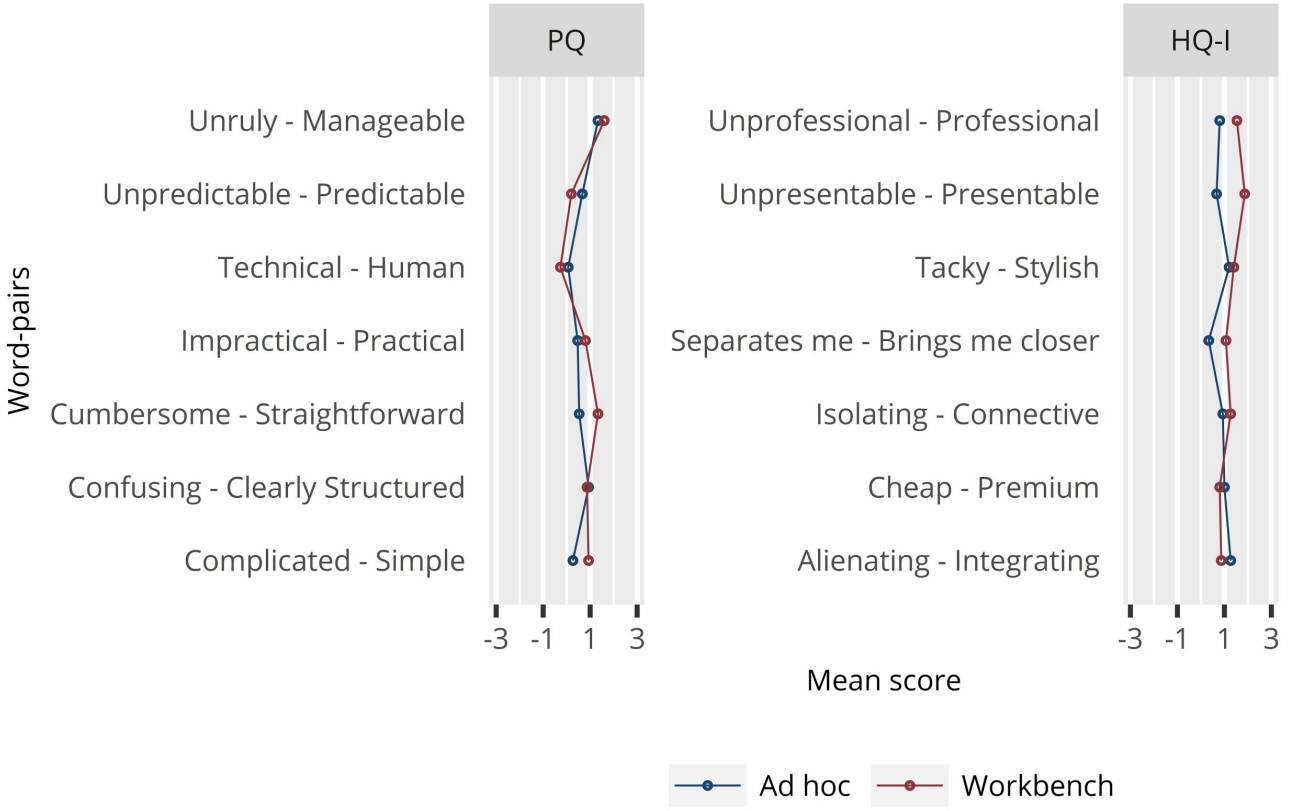
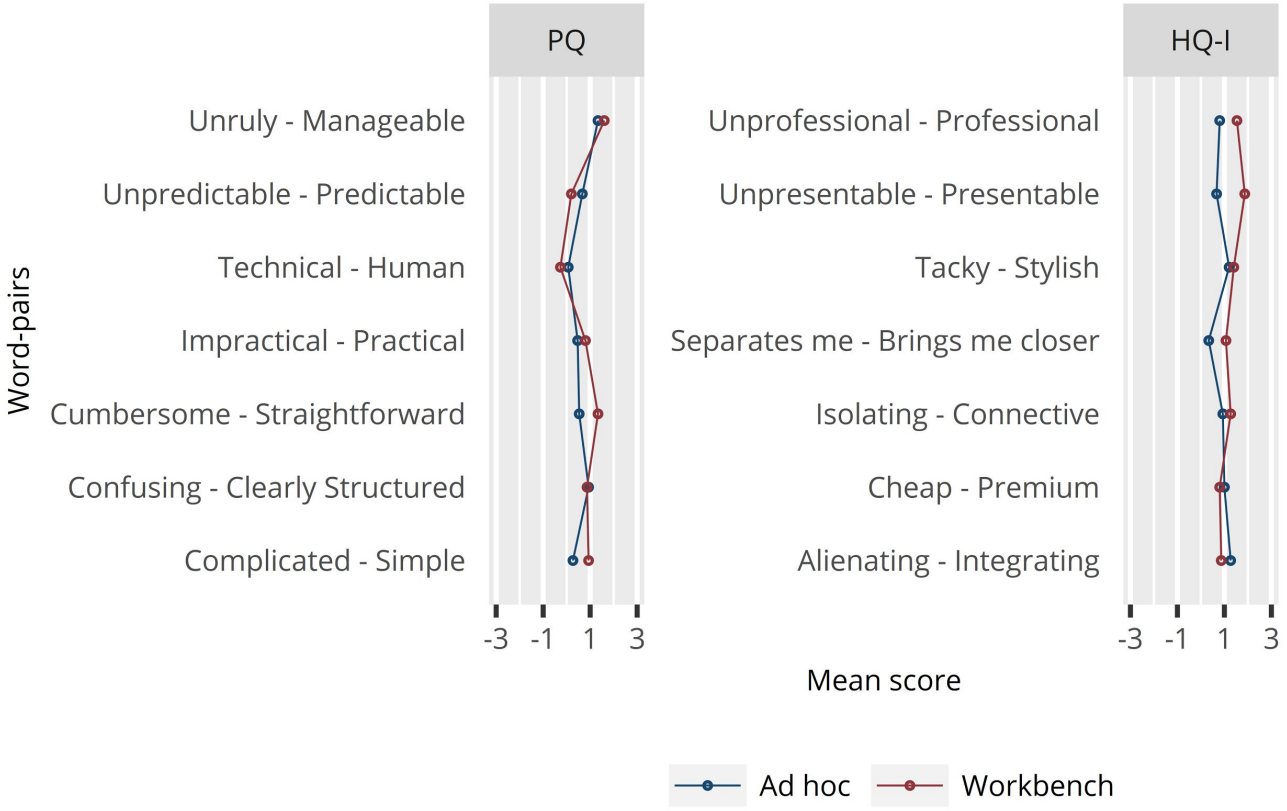
Study 1 results: AttrakDiff word-pairs (1)



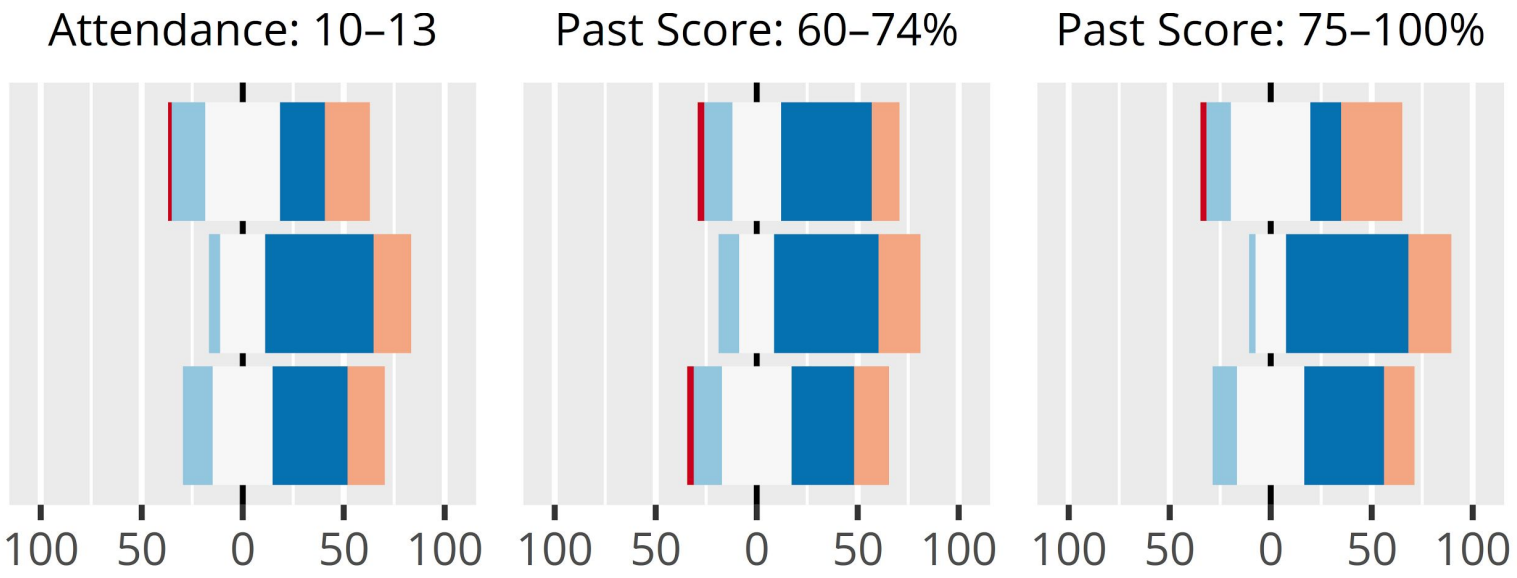
PQ and HQ-I word-pair means

Study 1 results: AttrakDiff word-pairs (2)



HQ-S and ATT word-pair means

Study 2 results: demographic learner responses (1)



Learner survey responses by demographic

Analysis 2: Demographic differences

- ISP levels
  -
- Teaching experience
  -
- Computing experience
  -