Understanding the effects of Streamlining the Orchestration of Learning Activities

Lighton Phiri (HPI-CS4A)

Supervisors:
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HPI-CS4A Spring Workshop | August 30 2016
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.

Source: http://www.uct.ac.za
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.
Streamlining orchestration

Using the concept of cross-plane integration [3] 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
Study 1: Ad hoc vs. organised orchestration (1)

PortableApps

Prototype Workbench

Ad hoc vs. Organised Orchestration (Under review).
Lighton Phiri, Christoph Meinel and Hussein Suleman.
T4E 2016.
Study 1: Ad hoc vs. organised orchestration (2)

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

<table>
<thead>
<tr>
<th>RQ</th>
<th>AH</th>
<th>Factor</th>
<th>Variable</th>
<th>Scale</th>
<th>Description</th>
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<tbody>
<tr>
<td>RQ1</td>
<td>H1</td>
<td>Task speed</td>
<td>$T_t$</td>
<td>Min</td>
<td>Task time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Success</td>
<td>PQ</td>
<td>[-3 – 3]</td>
<td>AttrakDiff 2</td>
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<tr>
<td></td>
<td></td>
<td>Comfort</td>
<td>HQ-I</td>
<td>[-3 – 3]</td>
<td>AttrakDiff 2</td>
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<tr>
<td>RQ2</td>
<td>H2</td>
<td>UX</td>
<td>HQ-*;ATT</td>
<td>[-3 – 3]</td>
<td>AttrakDiff 2</td>
</tr>
</tbody>
</table>
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

Comparison A–B

This type of study assesses each of the two different products separately and then compares them. You will be provided with an overview of how your customers perceive each of the products. You can decide whether both products are evaluated by the same test group, or whether product A and product B are evaluated by completely different test groups.

Source: http://attrakdiff.de
Study participants

61 participants from Cape Peninsula University of Technology recruited, with 55 of them completing all experimental tasks.

Participants’ levels of study ranged from second year to fourth year. In addition, participants had varying experience teaching and experience using computers.
Experimental design (1)

- Within-subject design using random experiment blocks

<table>
<thead>
<tr>
<th></th>
<th>Participants</th>
<th>Approach 1</th>
<th>Approach 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>29</td>
<td>Workbench</td>
<td>PortableApps</td>
</tr>
<tr>
<td>Group 2</td>
<td>26</td>
<td>PortableApps</td>
<td>Workbench</td>
</tr>
</tbody>
</table>
Experimental design (2)

- Two experimental conditions
  - IV: Orchestration technique
  - DV: Time on tasks; AttrakDiff 2 dimensions
  - CV: Level of study; Teaching experience; Computing experience

Pre-task activities  →  Orchestration tasks  →  Post-task activities
Results 1: Time on tasks

- On average, orchestration of learning activities was 21.0% faster using workbench

paired samples t-test; p-value < 0.05
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

paired samples t-test; PQ: p-value < 0.001; HQ-I: p-value < 0.001; HQ-S: p-value < 0.001; ATT: p-value < 0.001
Results 2: AttrakDiff 2 (2)

AttrakDiff 2 dimension means

- PQ; HQ-I; HQ-S; ATT
  - Mean score higher for workbench on average
- Further analysis of dimension means done using word-pairs

Paired samples t-test; PQ: p-value < 0.001; HQ-I: p-value < 0.001; HQ-S: p-value < 0.001; ATT: p-value < 0.001
Analysis 1: Technique effectiveness

Time on tasks

- On average participants orchestrated learning activities faster using workbench

AttrakDiff 2 dimensions

- Higher scores for PQ and HQ-I dimensions
- Participants’ perceived success at orchestrating learning activities greater using workbench
Analysis 2: User experiences

AttrakDiff 2 dimensions
- Higher scores for HQ-S and ATT dimensions

Participants’ comments
“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
Analysis 3: Counterbalancing

Potential impact of approach complexity during transition

<table>
<thead>
<tr>
<th></th>
<th>Approach 1</th>
<th>Approach 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>Workbench: 5.84 (2.30)</td>
<td>PortableApps: 7.44 (2.24)</td>
</tr>
<tr>
<td>Group 2</td>
<td>PortableApps: 6.10 (2.38)</td>
<td>Workbench: 5.32 (1.05)</td>
</tr>
</tbody>
</table>

Similar trends as overall results for dimension means

<table>
<thead>
<tr>
<th></th>
<th>Approach</th>
<th>PQ</th>
<th>HQ-I</th>
<th>HQ-S</th>
<th>ATT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>Workbench</td>
<td>0.83 (1.03)</td>
<td>1.27 (1.00)</td>
<td>0.82 (0.69)</td>
<td>1.46 (1.19)</td>
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<tr>
<td></td>
<td>PortableApps</td>
<td>-0.38 (1.09)</td>
<td>0.18 (0.72)</td>
<td>-0.11 (0.69)</td>
<td>0.32 (1.02)</td>
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<tr>
<td>Group 2</td>
<td>Workbench</td>
<td>1.22 (0.85)</td>
<td>1.79 (0.84)</td>
<td>1.01 (0.79)</td>
<td>2.05 (0.88)</td>
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<tr>
<td></td>
<td>PortableApps</td>
<td>0.25 (1.32)</td>
<td>0.62 (1.23)</td>
<td>0.19 (1.06)</td>
<td>0.80 (1.40)</td>
</tr>
</tbody>
</table>
Analysis 4: Demographic differences

The influence of control variables resulted in minor variations from overall results

- Participants' times of task patterns were similar for both approaches
- Fourth year students orchestrated activities quicker using both approaches
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

(1)

Streamlined Orchestration.


Source: https://youtu.be/x5s0aENwNMA
Study 2: Orchestrating a flipped class (2)

CSC2002S—Computer Architecture flipped class outline structure

Source: https://youtu.be/x5s0aENwNMA
Study 2: Orchestrating a flipped class (2)

CSC2002S—Computer Architecture flipped class outline structure

Source: https://youtu.be/x5s0aENwNMA
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?

<table>
<thead>
<tr>
<th>RQ</th>
<th>Object</th>
<th>Instrument</th>
<th>Scale</th>
<th>Description</th>
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<tbody>
<tr>
<td>RQ1</td>
<td>Educator</td>
<td>Video segments</td>
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<td>App usage</td>
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<td></td>
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<td>Interviews</td>
<td>[-3 – 3]</td>
<td>Interviews</td>
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<tr>
<td>RQ2</td>
<td>Learners</td>
<td>Survey</td>
<td>[-3 – 3]</td>
<td>Questionnaire</td>
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</tbody>
</table>
Study objectives (2)

Workbench UI implemented to orchestrate core activities

Source: http://media.uct.ac.za
Evaluation procedure (1)

(1) Usage

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

(2) Educator

(3) Learners
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

<table>
<thead>
<tr>
<th>Tool</th>
<th>Freq.</th>
<th>Duration</th>
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<td>Workbench</td>
<td>10</td>
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<tr>
<td>VideoGlide</td>
<td>8</td>
<td>00:07:56</td>
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<tr>
<td>Firefox</td>
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<td>00:21:29</td>
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<td>Impress</td>
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<td>00:38:26</td>
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<td>Robotic Arm</td>
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<tr>
<td>VirtualBox</td>
<td>1</td>
<td>00:00:58</td>
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</table>
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
Dynamic simple scripting

Dynamic scripting based of IMS Global Simple Sequencing

Course: CSC1010H
- Unit: 1) Introduction to CS
- Unit: 2) Python Basics
- Unit: 3) I/O, Strings & Numbers
- Unit: 4) Python Selection
- Unit: 5) Python Iteration
- Unit: 6) Data Structures

Add a unit
Add a course

Unit: 3) I/O, Strings & Numbers
Objectives
- Input/Output, Strings & Numbers

Resources

Source: http://simba.cs.uct.ac.za/indefero
Dynamic simple scripting

Basic CRUD functionality for management of activities

<table>
<thead>
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<tr>
<td>Unit: 2) Python Basics</td>
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<td>Unit: 6) Data Structures</td>
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Unit: 3) I/O, Strings & Numbers

Objectives
- Input/Output, Strings & Numbers

Resources

[Add a unit]
[Add a course]

Source: http://simba.cs.uct.ac.za/indefero
Dynamic simple scripting (2)

Pre-session directed sequencing of session activities

Course: CSC1010H

- Unit: 1) Introduction to CS
- Unit: 2) Python Basics
- Unit: 3) I/O, Strings & Numbers
- Unit: 4) Python Selection
- Unit: 5) Python Iteration
- Unit: 6) Data Structures

Add a unit
Add a course

Unit: 3) I/O, Strings & Numbers

Objectives
- Input/Output, Strings & Numbers

Resources

Source: http://simba.cs.uct.ac.za/indefero
Dynamic simple scripting (3)

Orchestration of sequenced session activities

- Current viewer leverages MS PPT
- API implemented to plug-in different viewer
- Reuse and remixing of sequenced session activities

Source: http://simba.cs.uct.ac.za/indefero
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
<table>
<thead>
<tr>
<th>#</th>
<th>Milestones</th>
<th>Timescale</th>
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<tr>
<td>1)</td>
<td>Study 3: Guided orchestration experiment</td>
<td>October 2016</td>
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<td>2)</td>
<td>CSEDU 2016 submission</td>
<td>December 2016</td>
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<td>3)</td>
<td>ICALT 2016 submission</td>
<td>January 2017</td>
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<td>4)</td>
<td>Study 4: Dynamic enactment experiment</td>
<td>February 2017</td>
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<td>5)</td>
<td>Thesis draft manuscript</td>
<td>May 2017</td>
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<td>6)</td>
<td>Thesis final submission</td>
<td>June 2017</td>
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<td>7)</td>
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Study 1: AttrakDiff word-pairs (1)

PQ and HQ-I word-pair means

- Unruly - Manageable
- Unpredictable - Predictable
- Technical - Human
- Impractical - Practical
- Cumbersome - Straightforward
- Confusing - Clearly Structured
- Complicated - Simple

- Unprofessional - Professional
- Unpresentable - Presentable
- Tacky - Stylish
- Separates me - Brings me closer
- Isolating - Connective
- Cheap - Premium
- Alienating - Integrating

Mean score

PQ and HQ-I word-pair means
Study 1: AttrakDiff word-pairs (2)

HQ-S and ATT word-pair means
Study 2: Learner demographic differences (1)

Learner survey responses by demographic