Whither Seamless Learning: Perspectives, Challenges and Opportunities

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Greetings from Singapore!
Where are we coming from? (when we started in 2008)

• Many countries are going 1:1, what is a good pedagogical model that is sustainable?

A day that will live in infamy for educational technologies

Education

Seeing No Progress, Some Schools Drop Laptops
Was 1:1 working?

• 1:1 m-education is experiencing exponential growth.
• Many 1:1 initiatives are not sustainable!

Education in Peru:
A disappointing return from an investment in computing

*The Economist, April 7, 2012: “children receiving the computers did not show any improvement in maths or reading. Nor did it find evidence that access to a laptop increased motivation, or time devoted to homework or reading”*
Where are we also coming from?

• How to bridge formal and informal learning?
• To facilitate **continuity** of learning, cross-temporal and cross-spatial
  
  • Formal + informal learning
  • Individual + social/collaborative learning
  • Learning in physical + digital spaces ...

• Not just **contextualise**, but “**recontextualise**” learning => to achieve deeper learning

• Ultimately, to nurture **lifelong learners**


What is Seamless Learning?

Bridging
Recontextualising

Learn
Reflect
Apply

Learn
Relearn
Unlearn

A trajectory of research work

Seamless science pedagogy: P3-P4
Piloted @ 1 class, Primary School in Singapore (SG)

Science + English, P3-P4
Level-wide scaling up in Primary School

Diffused to 10 more schools

PD: 4 science teachers (began)
PD: teachers of entire level (began)
PD: 10-school teachers’ PD began

Work in Singapore: Science lessons via mobile learning in a Primary 3 & 4 classes
Bridging Formal and Informal Learning Spaces for Self-Directed & Collaborative Inquiry Learning in Science
Planned and emergent learning spaces mediated by 1:1 mobile devices

<table>
<thead>
<tr>
<th>Type</th>
<th>Planned Learning</th>
<th>Emergent Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Out Class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type II</td>
<td>Planned learning out of class</td>
<td>Emergent learning out of class</td>
</tr>
<tr>
<td></td>
<td>E.g. Field trip to heritage site which is part of a school curriculum</td>
<td>E.g. Using mobile phones to capture pictures and video clips of animal and directed by self-interest</td>
</tr>
<tr>
<td>In Class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type I</td>
<td>Planned learning in class</td>
<td>Emergent learning in class</td>
</tr>
<tr>
<td></td>
<td>E.g. Searching for answers in the classroom</td>
<td>E.g. teachable moments not planned by the teachers</td>
</tr>
</tbody>
</table>

SEAMLESS Learning of Science in the school

Mobilized 5E Science Curriculum (M5ESC)
Lesson Package
For learning Plant Systems

Goals of Lesson

Experiment (video)

KWL

Comparison Table

PiCo Map

Sketchy

Taking Sketchy PiCo Map
Principles for Designing a Seamless Learning Curricular Innovation

1. Design for emergent learning, and for personally and socially meaningful goals
2. Making thinking visible
3. Plan for enough time to do learning activities
4. Design for technology ready-at-hand (in and out of class)
5. Design for seamlessness (bridging across contexts)
6. Design alternative assessments (to test new competencies)
7. Design not for direct conversion from paper-based curriculum

Design commitments

• key epistemological design commitments
  • learning as drawing connections between ideas, and
  • learning as connecting science to everyday lives, and across multiple learning spaces

• curricular commitment
  • 5E model
  • seamless learning, and
  • inquiry-based facilitation and learning.

• technological commitments include:
  • **technology for connecting learning efforts across time and space**
    • technology for construction,
    • technology for communication, and
    • technology for searching information anywhere anytime.

Use of Mobile Technologies across different learning spaces and learning of Science

Studying artefacts created by the students in and out of class through the use of the Smartphones

Exploring Students' Progression

Student Module

Proposed cognitive levels of learning activities

<table>
<thead>
<tr>
<th>Learning tools</th>
<th>Level 1: Doing</th>
<th>Level 2: Thinking about connections</th>
<th>Level 3: Thinking about concepts</th>
<th>Level 4: Critiquing and evaluating</th>
<th>Level 5: Creating knowledge</th>
<th>Level 6: Sharing knowledge</th>
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</thead>
<tbody>
<tr>
<td>KWL</td>
<td>✓</td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Sketchbook</td>
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<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
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<tr>
<td>MapIT</td>
<td></td>
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<tr>
<td>Blurb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>NotePad</td>
<td>✓</td>
<td></td>
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<td></td>
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<tr>
<td>Recorder</td>
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<td></td>
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<tr>
<td>SamEx</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
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</tr>
</tbody>
</table>

Assessing Activity Performance

Activity performance & attitudes, skills, and knowledge:

• Individual & collaborative activities
• Mobile & non-mobile activities
• In class & out of class activities
Assessing learning artefacts

- Degree of completion
- Levels of reflections in KWL
- Quality levels of concept map in MapIT
- Quality levels of representations in Sketchbook
Location-based Knowledge Building

Using Google Maps for In-Situ Location-based Knowledge building

**Impressions and Queries**

**Input of Content Knowledge of Place**

**Revision and changes in Perspectives**

**Sharing and comparing of information**

**Conciliation and co-construction of knowledge**

**Peer questioning and collaboration**

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Henry: Coolie house and Opium den
IMPRESSION: I thought a coolie house was for coolies to live in. I also thought opium dens were for coolies to smoke opium.
RESEARCH: A coolie house is for Chinese workers to live in. An opium den was for those Chinese workers to smoke opium.

William: When were the coolie houses built?

Jia Wei: Who built this opium dens and coolie houses?

Ming: Some coolie houses are actually Opium Dens. Did you know that?

Initially, I thought that coolie houses and opium dens were 2 different things, but now I know that some opium dens were actually coolie houses. I am afraid these houses will be demolished because they are old and looks like they may collapse any time.
SamEx – Experience Sampling

- Capture the in-situ experiences of students
- Questions to students can be triggered by time or location
- Students can make ad-hoc postings to report their interests
- Postings can be shared among students
- Postings can be location-based if there is GPS or available locale information

SamEx – Digital Badges

• Students earn digital badges as they gain inquiry skills: observation, asking questions and explaining
• Students can progress to different levels of competency and skills
Transformation: Students learned science better and became Self-directed & Collaborative Learners

Observing

Doing

Discussing

Recording
Effectiveness: experimental vs control classes in the first year of implementation

- Used ANCOVA method to test – to control the exam scores before the introduction of the seamless science lessons constant
- The finding: the experimental class 3E had the highest exam scores which were statistically significant than ALL other control classes

<table>
<thead>
<tr>
<th>Class</th>
<th>N</th>
<th>Mean Total year-end score</th>
<th>SD</th>
<th>Adjusted mean Total year-end score</th>
</tr>
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<tbody>
<tr>
<td>3D</td>
<td>39</td>
<td>75.49</td>
<td>7.786</td>
<td>71.50</td>
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<tr>
<td><strong>3E</strong></td>
<td>39</td>
<td><strong>76.67</strong></td>
<td><strong>8.588</strong></td>
<td><strong>74.11</strong></td>
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<tr>
<td>3F</td>
<td>41</td>
<td>71.63</td>
<td>8.952</td>
<td>68.22</td>
</tr>
<tr>
<td>3G</td>
<td>36</td>
<td>41.36</td>
<td>16.507</td>
<td>48.90</td>
</tr>
<tr>
<td>3H</td>
<td>40</td>
<td>55.95</td>
<td>12.704</td>
<td>59.31</td>
</tr>
<tr>
<td>3I</td>
<td>39</td>
<td>72.13</td>
<td>7.706</td>
<td>71.87</td>
</tr>
<tr>
<td>Total</td>
<td>351</td>
<td>72.25</td>
<td>16.528</td>
<td>71.50</td>
</tr>
</tbody>
</table>

Effectiveness: Science results in various years

(MCQ = multiple choice questions; OEQ = open-ended questions)

- Also showing improvement in higher-order thinking

# Students’ Attitudes towards the use of Mobile Devices

Results of paired-sample t test on students’ attitudes after one year of implementation (N=39)

<table>
<thead>
<tr>
<th></th>
<th>Feb Survey</th>
<th>Sep Survey</th>
<th>Mean</th>
<th>Std Deviation</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile device helps me learn my class subject</td>
<td>1.46</td>
<td>1.82</td>
<td>1.46</td>
<td>.643</td>
<td>-2.765**</td>
</tr>
<tr>
<td></td>
<td>1.82</td>
<td></td>
<td>.643</td>
<td>.451</td>
<td></td>
</tr>
<tr>
<td>Mobile device helps me learn things outside of school</td>
<td>1.42</td>
<td>1.76</td>
<td>1.42</td>
<td>.683</td>
<td>-2.321*</td>
</tr>
<tr>
<td></td>
<td>1.76</td>
<td></td>
<td>.683</td>
<td>.490</td>
<td></td>
</tr>
<tr>
<td>I like the learning activities using computers and gadgets.</td>
<td>1.05</td>
<td>1.23</td>
<td>1.05</td>
<td>.223</td>
<td>-2.016*</td>
</tr>
<tr>
<td></td>
<td>1.23</td>
<td></td>
<td>.223</td>
<td>.536</td>
<td></td>
</tr>
<tr>
<td>I learn more when I work in a group than alone</td>
<td>1.37</td>
<td>1.68</td>
<td>1.37</td>
<td>.633</td>
<td>-2.634*</td>
</tr>
<tr>
<td></td>
<td>1.68</td>
<td></td>
<td>.633</td>
<td>.662</td>
<td></td>
</tr>
</tbody>
</table>

*p<.05, **p<.01.
Current Projects derived from Seamless Learning

- Technology-Supported Questioning Platform – SMILE
  - An inquiry maker, mobile learning management software designed to support student-centred inquiry and thinking in a classroom setting. (Buckner & Kim, 2014)

• a SMILE-based pedagogical model derived from Seamless Learning for classroom inquiry.

• such pedagogical model supports the rebalancing of the roles of teachers as facilitators of learning and help students further their understanding by leading students in the construction of questions.

• The experimental class showed the following gains: MCQs ($t = 5.36^{***}$, $p < .001$), Open-ended ($t = 2.086^*$, $p < .05$) and Total ($t = 6.224^{***}$, $p < .001$).

• No significant gains found for Open-ended Questions ($t = .161$, $p > .05$) in control class.

Wu, L., Looi, C.K., & He, S. (submitted for publication) Enacting Questioning for Inquiry-based Elementary Science Classroom
Ongoing project: Streamlining the designs of seamless science learning for wider diffusion
So where are we now?

• Books & handbooks & encyclopedias
• Journal articles and conference papers
• Presentations and videos
• Lesson plans for SL in science, language learning
So what we have:

• Design frameworks
• Design principles
• School curricula
• Apps
• Architectural frameworks
• Empirical studies
• Many similar or related terms, like crossover learning, incidental learning, learning in context, etc
Reports of Seamless Learning

- **Knowledge co-construction** ... seamlessly: Maldonado & Pea (2010); So, Tan & Tay (2012); Zhang & Maesako (2009)
- **Personalized learning** ... seamlessly: Obisat & Hattab (2009); Tabuenca et al. (2012)
- **Self-regulated/directed learning** ... seamlessly: Sha (in-press); El-Bishouty (2010); Ozdamli (2013); Wong (2013)
- **Flipped Classroom/Learning** ... seamlessly: Hwang, Lai & Wang (2015)
- **Workplace learning**: Chatti, Thus, Geven & Schroeder (2016); Katz, Borner, Ternier & Specht (2015)
- **Lifelong learning** ... seamlessly: Kalz (in-press); Seta et al. (2014)
COLLEGE/WORKplace/ADULT Seamless learning

- **Natural Science**: Rogers & Price (2008)
- **Geology, architecture, social sciences**: Zurita & Baloian (2012)
- **Marketing**: Baloian & Zurita (2012)
- **Computer tech.**: Fotouchi-Ghazvini (2011); Liao et al. (2009)
- **Medicine**: Metcalf, Jackson & Rogers (2015)
- **Cyber-safety & logic**: Miyata et al. (2010)
- **Security & defense**: Glahn (2015)
- **Automotive**: Metcalf, Jackson & Rogers (2015)
- **Language**: Uosaki et al. (2010); Ogata et al. (2008); Foomani & Hedayati (2016)
- **Vocational internship**: Lin et al. (2008)
More research work is needed!

• Learning theories and mechanisms
• Deeper understanding of informal learning
• More empirical studies

.... And also methodologies for studying SL
The theorisation
What theoretical foundation?

• It depends on which seams you cross
• Crossing individual and social learning spaces
  • Group cognition
• Crossing formal and informal learning spaces
  • Situated learning
  • Re-contextualizing learning
• Crossing physical and digital spaces
  • Blended learning
  • Learning with different affordances/interactive experiences
• Cross time
  • Cognition
  • Social-cultural theories
• Challenge: some over-arching theory underpinning SL
Informal and Formal Learning

(LIFE Center: Stevens, R. Bransford, J. & Stevens, A., 2005)
Principles on learning in and out of school

• Learning is situated in broad socio-economic and historical contexts and is mediated by local cultural practices and perspectives.

• **Learning takes place not only in school but also in the multiple contexts and valued practices of everyday lives across the life span.**

• All learners need multiple sources of support from a variety of institutions to promote their personal and intellectual development.

• **Learning is facilitated when learners are encouraged to use their home and community language resources as a basis for expanding their linguistic repertoires.**

Frame SL by principles of Distributed cognition (Hutchins, 1995)

Cognition is distributed, social and at times personal

- Personalized learning stimulated by social learning, and vice versa
- Ownership and commitment to learning
- Learning by creating representations and building knowledge

Facilitated Seamless Learning (FSL) Process Framework

Situatedness of learning experiences yet re-contextualizing them

- Recontextualization of learning
- Making salient connections between learning situations
- Understand the role of multiple representations
- External representations to help make connections
- Metacognition as the bridge
Reiterating the link to mobile learning:
SL is an ecological approach to mobile learning

• Transformation of daily lives into learning spaces
• Focus on the mobility of the learner and the experience of learning with mobile devices
• “Cultural/learning resources” and the role they play in daily life as strategic tools for (Ranieri & Bruni, 2012)
  • Identify formation
  • Social interaction
  • Deriving meaning
  • Entertainment
Treat device as a “learning hub”

• From 1:1 (or BYOD) to “division of labour”

10 Dimensions of Mobile Seamless Learning (10D-MSL)


Are there new seams?
Crossing a new seam (the then and the now) – *seam number 11?*

- Bridging “now and then”
- Situated learning
  - learning takes place within an authentic activity and context (Lave & Wenger)
  - learner starts to take on the actual practices, language and ways of thinking or identity of the subject
- Example: Create emotional impact by bringing students back to the past using VR
Crossing a new seam
(the **learning** and the **assessment**)  
*seam number 12?*

- Bridging learning and assessment
- Design for such bridging
  - Formative assessment
  - Bridging
- Design to bring alignment between for learning for learning sake vs learning for signifying/certification sake
Some questions to reflect upon
Q1: Does learning happen all the time?

1. Yes
2. No
3. Depends on what you mean “all the time”
4. Depends on what you mean by learning
Q2: What is Seamless Learning?

1. Describing a reality in life
2. A metaphor, a motto, a mantra to improve learning
3. A pedagogy
4. An ideal
Q3: Should all learning be seamless learning?

- Yes
- No
- Depends on who we go with to the science centre/museum (parents, friends or parents)
- Depends on what kinds of learning experiences
Q4: Can Seamless Learning happen without technology?

1. Yes
2. Of course, not
3. Under some situations (what situations?)
SL is a metaphor

• **Remove the seams**
• **Break down** barriers between formal learning environments and informal ones
• **Blur** the boundaries
• **Integrate** informal and formal learning contexts
• **Bridge** relationship between school and out-of-school
e.g. Blur the boundaries between school and the real world

• Assumption: practice is something that only comes after learning
• Follow a continuum of integrated learning and practice
• “Real world” learning experiences are more than simple “applications” of classroom learning (Mark, 2009)
long-tail learning ecosystem (Brown & Adler, 2008) & (Roschelle, 2010)
Still much opportunities for the design of continuous learning

• How to enculturate self-directed learning?
  • How to promote the long-tail?

• Schools still provide core knowledge in the tall end

• SL as an approach to bridge, to motivate interest, to support own learning needs and preferences

• Design for SL: about creating rich experiences across the learning spaces/contexts
  • Not silo-ed in the classroom
  • But engagement whenever the learner is ready
Next Springer book on SL:

• External representations (Nuno Otero & Ian Oakley)
• Designing architectural approaches to supporting collaborative SL experiences (Dan Kohen-Vacs, Marcelo Milrad, Marc Jansen)
• Learning problems behind the seams in SL (Bernadette Dilger, Luci Gommers & Christian Rapp)
• How do sensors contextualize learning for SL? (Marcus Specht, LB Hang & J S Barnes)
• How do design boundary objects for science learning? (Daner Sun & Chee-Kit Looi)
Need and opportunities for research

• Design more continuous learning experiences
• Mobile learning to be more ubiquitous, crossing borders, cultures, ages ...
• How to leverage on technological advancements, such as AI and learning analytics, to inform or support SL?
• Theorisation of SL
The End

Thanks to Lung-Hsiang Wong, long-time collaborator in SL, for some of the slides
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