Between “Authentic” and “Inauthentic” Education Investments: The Forensic Science Genre

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Part I:
Forensic Science Education: Investigation into Current Tertiary Forensic Science Courses
Why Forensic Science Education?

- Development of democracies which favours scientific evidence versus “confession at any price” evidence
- Technological advancements impacting various forensic science disciplines
- Media obsession with Forensic Science in a manner similar to-if not exceeding-that associating/following the “Apollo space program” 1961–1975 (Houck, 2006).
- Public obsession with forensic science
- Drastic Security Challenges (e.g. Terrorism, mass murders, etc) which lead government towards more investment in the various forensic science sectors
Statistics (American Ratings)

American Ratings of the CSI Show - CBS

Viewers in Millions

<table>
<thead>
<tr>
<th>Year</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-2001</td>
<td>20.8</td>
</tr>
<tr>
<td>2001-2002</td>
<td>23.7</td>
</tr>
<tr>
<td>2003-2004</td>
<td>25.27</td>
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<tr>
<td>2004-2005</td>
<td>26.26</td>
</tr>
<tr>
<td>2005-2006</td>
<td>24.86</td>
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<tr>
<td>2006-2007</td>
<td>20.34</td>
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<tr>
<td>2007-2008</td>
<td>16.62</td>
</tr>
<tr>
<td>2008-2009</td>
<td>18.52</td>
</tr>
<tr>
<td>2009-2010</td>
<td>14.92</td>
</tr>
<tr>
<td>2010-2011</td>
<td>13.52</td>
</tr>
<tr>
<td>2011-2012</td>
<td>12.49</td>
</tr>
</tbody>
</table>
Statistics (International Ratings)

- Followed by 73.8 million viewers worldwide (2010)
  ✓ Ranked amongst the top U.S. series in Australia, France, Germany, Italy, Poland, Spain and the U.K.

- Followed by 63 million viewers worldwide (2012)
  ✓ The International Television Audience Award for a Drama TV Series for the 5th time by the Festival de Télévision de Monte-Carlo
Dramatic increase in the number of forensic science courses/programs offered worldwide
Impact on Education

- In Australia: 1 university in 1994 to nearly 20 universities in 2005
- In the U.K: 2,191 students in 2002-03 to 5,664 in 2007-08
- Few courses - mainly chemistry - started enjoying the adjective "forensic"
“Every third person on the planet wants to be a forensic scientist” (Smallwood, 2002:1)

Every third education course/program on the planet started enjoying the adjective ‘forensic’ in its title
Aim

Despite the rapid expansion in forensic science courses worldwide:

- Very little research is conducted on forensic science education and training
- Nearly null inquiries - except for few reports - is carried into forensic science tertiary courses

The aim of the research is to:

- generate education insights and understandings relating to forensic science
- initiate a literature on this subject matter
Methodology: Document Analysis

- In order to inquire into forensic science education, a study on 190 listed forensic courses was conducted.

- The study comprised document analysis of the listed courses.

- Document analysis implemented both quantitative and qualitative approaches throughout the research journey.
The List of 190 courses

Document analysis started with a list of 190 courses. This list was formed by inspection of various sources which provide information about institutes offering forensic science courses/programs:

- Official Forensic Science Websites (e.g. AAFS; NIFS)
- Publications (e.g. Camenson, 2001; Genge, 2002)
Document Analysis: 3-Stage Selection Criteria

- **1st Stage of Selection:**
  - Exclusion-Based Criterion

- **2nd Stage of Selection:**
  - Pattern/ Categories Identification Criterion

- **3rd Stage of Selection:**
  - Points- Based Criterion
190 Courses/Programs

1st Stage Selection

78 Courses

2nd Stage Selection

Classified & Categorised 78 Courses

3rd Stage Selection

15 Courses

Preliminary Notes

Qual. & Quant. Analysis

CC Analysis
Statistics - Bar Chart 1

Programs' Distribution across Administering Departments

- Public Safety Departments: 5%
- Multi-Departmental Programs: 6.25%
- Biology Departments: 10%
- Other Departments: 11.25%
- Departments of Criminal Justice: 13.75%
- Other (Science) Departments: 15%
- Stand-alone Forensic Science Departments: 16.25%
- Chemistry Departments: 22.50%
Statistics - Bar Chart 2

Programs' Distribution across the Five Categorised Groups

Group V: Undegraduate and Postgraduate Degrees: 13.93%
Group II: Minor Degrees: 16.45%
Group I: Non-Award Degrees: 17.72%
Group IV: Postgraduate Degrees: 19%
Group III: Undegraduate Degrees: 32.90%
Forensic Science Education: Curricular Approaches

- The multidisciplinary approach: cross-disciplinary interaction between different disciplines; however, keeping subjects’ content distinct and finally using the methods of one discipline in its examination (Boundaries maintained)

- The interdisciplinary approach: allows the integration of two or more disciplines in pursuit of a specific forensic science topic (Boundaries are blurred)
Multidisciplinary v.s. Interdisciplinary

- Ratio Multi- Versus Inter- was 1:2; This ratio is risky for several reasons:
  - Risk of concealment of the fundamental science knowledge-base
  - Risk of graduating students who are not specialists: “bits & pieces graduates”
  - Risk of locking students into the one career opportunity- if at all
Forensic Science Education: Pedagogic Approaches

- Document analysis revealed that teaching and learning within the courses were conducted via various formats:
  - Traditional lecture-based learning
  - Experimental-based learning through laboratory classes
  - Problem-based learning (e.g. mock-up crime scene)
  - Practice-based learning (in collaboration with an external supervisor)
  - Seminars, Workshops & Conferences
Forensic Science Education: Pedagogic Approaches

- Praxis inquiry pedagogies took place through:
  - Only laboratory work (LW) within the university
  - LW, seminars, and visits to relevant agencies
  - LW, mock-up homicide scenes, moot courts, and practicum experience (re-study & analysis of real cold cases)
  - LW within university and on-site training (several weeks placements)
  - Through LW within university and practice-based internship (1 year)
Practitioners’ Contributions in Course Pedagogy

Practitioners’ contributions to course pedagogy were mainly emphasised in three forms:

- **Major Contribution (67%)**: majority of the subjects were taught by forensic practitioners or academics who were previously practitioners in the field.
- **Specific-Subject Contribution (27%)**: practitioners taught specific subjects within the curriculum. Such subjects were often of an ‘explicit’ forensic nature.
- **Minor/Minimal Contribution (6%)**: practitioners’ involvements in course delivery were limited to seminars, workshops, etc.
Accreditation/Association with External Authorities

- 47% revealed a direct relation with police departments: state & federal
- 73% emphasised a link with professional forensic science associations such as AAFS, NIFS & ANZFSS, and Forensic Science Society in the U.K.
- One third revealed links with forensic science agencies.
- 27% recognised/accredited by their national chemical association
- 60% possessed links with more than one external authority.
Potential Career Opportunities

- Forensic practitioner (83%)
- Police member (58%)
- Practicing scientist (e.g. chemist) in chemical, pharmaceutical, and food industries (50%)
- Public servants in positions such as army, customs, immigration, national centres for missing people (42%).
- Environmental scientists (25%)
- Insurance Consultants (17%)
Generated Insights

- Forensic science is a very segmented field “practically” & “academically”
- Forensic science education suffers uncertainty in regards to:
  - The level of academic offer
  - The identity of administering departments
- Differentiation exists between field practice and laboratory practice in terms of education, jobs prerequisite, and identity of practitioners
- Forensic science courses possess industry links in a manner proportional to the extent of ‘socialisation’ between the university itself and the relevant law enforcement authorities.
Forensic science education is a function of a number of variables, the most major of which are:

a. **Education provider** (policies, resources, and connections with forensic science stakeholders)

b. **Individual jurisdictions**

c. **Police authority and practices**

d. **Industry size** (available career opportunities)

e. **Professional bodies & associations** (e.g. IAFS, AAFS, ANZFSS, MAFS, NIFS).
Sustainability of Forensic Science Courses:

What Follows

Forensic Science Courses receive both:

- Authentic investments:
  - Knowledge
  - Practice
  - Identity

- Inauthentic investments
  - Knowledge
  - Practice
  - Identity
Education? or What?
Police Culture
Culture of command, order, secrecy, and prescribed manner of carrying tasks.

Science Culture
Culture of empiricism, openness, and peer-reviewed practices.

Judicial Culture
Culture of bureaucracy, a legacy of norms, and beyond reasonable doubt evidence.

Forensic Science Education
Education relating to the multi-faceted complex nature of the forensic science profession:

- Scientific/Medical Culture
- Quasi-Military Culture
- Legal Culture
PART II: Forensic Science as a STEM PBL DEVICE
Why Forensic Science?
The Forensic Obsession!
When will be the next public shift?
Signs of Public Shift!

- In the week ending 7th April, 2013 (CBS top programs):
  - The Big Bang Theory # 1
  - CSI # 20

<table>
<thead>
<tr>
<th></th>
<th>Millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Big Bang Theory</td>
<td>17.24</td>
</tr>
<tr>
<td>CSI</td>
<td>9.89</td>
</tr>
</tbody>
</table>
Our Aim...

• Maintain and sustain students’ interest in mathematics and science independent of TV dramas.

• Explore with our students the real beauty of science with all its certainties, uncertainties, and the whole range of experiences within (critical thinking, problem solving, etc).

• Promote L&T in mathematics and science (STEM) in an engaging manner and through real-life settings.
To fulfil our aim...

As a PBL Device

Within a STEM Curricular Approach
STEM (Philosophical Stance)

- Basil Bernstein’s Social Solidarity:
  - ‘Mechanical solidarity’: individuals share a common system of beliefs, opinions and attitudes.
  - ‘Organic solidarity’ differences between individuals relate to each other to express achieved roles.
## Collection-code vs Integrated-code

<table>
<thead>
<tr>
<th>Overall Approach</th>
<th>Collection-Code Type Curriculum</th>
<th>Integrated-Code Type Curriculum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Implication</td>
<td>‘education in depth’</td>
<td>‘education in breadth’</td>
</tr>
<tr>
<td>Unifying Principle</td>
<td>mechanical solidarity</td>
<td>organic solidarity</td>
</tr>
<tr>
<td>Contents</td>
<td>subject or discipline</td>
<td>theme or topic</td>
</tr>
<tr>
<td>High-status contents stand in a ‘closed relation’ where subjects are clearly bounded and separated</td>
<td>high-status contents stand in an ‘open relation’ to one another</td>
<td></td>
</tr>
<tr>
<td>Syllabus</td>
<td>syllabus of each content is under the authority of the academics delivering these contents</td>
<td>syllabus is subordinate to a general idea which is ‘supra-subject’ and which governs the relationship between subjects</td>
</tr>
<tr>
<td>Pedagogy</td>
<td>individual pedagogies which proceeds from the surface structure of the knowledge to the deep structure</td>
<td>common pedagogies which proceed from the deep structure to the surface structure</td>
</tr>
<tr>
<td>Knowledge Emphasis</td>
<td>emphasis on states of knowledge</td>
<td>emphasis on ways of knowing</td>
</tr>
<tr>
<td>Structure</td>
<td>rigid, differentiating, systematic, and hierarchical</td>
<td>flexible and promoting students’ engagement in curriculum planning and development</td>
</tr>
</tbody>
</table>
Forensic Science as a PBL device

Ill-Structured Problem $\times$

{ Seeds of Interest
  + Significant Concepts
  + Real-World Connections

= Powerful opportunities for learning

Torp & Sage (1998:15)
Forensic Science as a PBL device

What solution fits best?

What do we know?

What do we need to know?

What have we learned?

Problem Solving

Clarke et al. (1998: 5)
Forensics as a PBL Device
Measurement (Initial Planning: Pre-STEM)

- **Topic: Measurement**
  - Pedagogic Approach: PBL- Estimating the Stature from Ear Prints
  - Underpinning Mathematical Knowledge:
    - Additive Thinking
    - Multiplicative Thinking
  - Levels:
    - Upper Primary- Lower Secondary
    - VCE (Scatter Plot & Correlation Extensions)
Setting the PBL Scene

• The Problem:

Mrs Smith reported a burglary. All her jewellery were stolen. Sarah from the CSI Squad attended the scene: the thief broke and entered the Smiths’ residence and left without leaving any trace except an ear print on the front door at a height x cm from the ground.

The police is interrogating three suspects with very little evidence: Suspect A (166cm), Suspect B (177cm), and Suspect C (184 cm). Sarah is required to assist the police in their investigation. Can you help Sarah?
Getting Started

• Prompting Curiosity & Excitement

  Curiosity Killed the Cat!

  But Knowledge about Ear Prints Brought her Back!

• Initiating students’ inquiries across the obvious certainties and the challenging uncertainties
Getting Started

• Initiating the inquiry:
  o How can we help Sarah?
  o How might an ear print imprinted on the window glass at a height x cm help?
  o Can we estimate the height of ...? How?
  o What are the variables included?
  o What do you think are the obvious/expected sources of error
Initial Discussion
Building up the Formula!

\[ H_E = H_1 + H_2 + H_3 - H_4 \]
Measurements to be Conducted

\[ H_E = (H_1 + H_2 + H_3) - H_4 \]

- The height of the ear imprint from the floor is measured (denoted as \( H_1 \)).
- The distance between the auditory canal and the top of the head is estimated (denoted as \( H_2 \)).
- The centimetres lost from the inclination when leaning towards a window or door to listen is estimated (denoted as \( H_3 \)).
- The extra centimetres added by the heels of the shoes is estimated as well (denoted as \( H_4 \)).
Getting the Forensic Work Done

Calculation:
Discussions

- How did we attempt the problem?
- What do we know?
- What do we need to know?
- What have we learned?
Extending the lesson to a VCE level

- Students to investigate any correlation between stature and height of the ear imprint
  
  - Determine the line of best fit:
    \[ Y(\text{stature}) = mX(\text{height of imprint}) + C \]
  
  - Analyse the relationship between the stature (Y) and the height of the ear imprint (X):
    - Pearson correlation coefficient \( (r) \)
    - Coefficient of determination \( (r^2) \)

(Lugt et al., 2005:137)
The Education “Leaves” Integrated within the STEM PBL Forensic Activity

- Design
- Biometric Engineering

Engineering

Technology
- ICT employed
- Calculators
- Excel, Mathematica, etc

Science

Forensics
Science Nature
Sources of Error (% Error)

Maths
- Modelling
- Measurement
- Statistics
Research & Publications

- Samarji, A. (2014). How Problematic is Problem-Based Learning (PBL)? The Case Study of Medicine Education. *Annals of Behavioral Science and Medical Education*, 20(2).


  


- STEM Education Research (Ongoing VU & LAU)

- CSI Effect and Science Education:
Mathematics and science deserve proper curricular attention and pedagogical planning.

In an era driven more on concepts and competencies across disciplines, science and mathematics education can be efficiently facilitated through a STEM Curricular approach associated with an effective pedagogical approach (e.g. PBL).
The Education Narrative

- Forensic science:
  - “Organically” problem-based
  - Cross-disciplinary enough to be “STEMMed” and cater to a diverse range of concepts across many disciplines
  - Prompt T&L environments which are engaging and exciting, benefitting from public interest in forensics
  - Prompt a variety of essential skills
Thank You!

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References & Bibliography

- Bibel, S (2012), ‘CSI: Crime Scene Investigation’ is the most-watched show in the world, *TV by the Numbers*, accessed: 11/03/2013:

- Gorman, B (2010), *CSI: Crime Scene Investigation* is the most watched show in the world, *TV by the Numbers*, accessed: 11/03/2013:


- Kondolojy,A (2013). ‘Big Bang’ College Hoops and Country Music are the top three broadcasts of the week, *TV by the Numbers*, accessed: 11/04/2013:


Thanks For Your Time

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