Learning and Teaching Investment Fund 2009

Final Report

Interactive Electronic Atlas (ieA)

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1: Project title
The title of the 2009 LTIF funded project is the Interactive Electronic Atlas (ieA)

2: Project leader
Dr Heather R Pisani: School of Health Sciences

3: Project Team
Dr Richard Guy: School of Medical Sciences
Dr Peter Rich: School of Medical Sciences
Mr Giovanni Mandarano: School of Medical Sciences
Dr Tom Molyneux: School of Health Sciences
Ms Cathy Leahy: School of Health Sciences

4: Funds approved
The requested and approved funds for this project were $60,278.00

5: Funds acquitted (attach financial statement)
As per attached financial statement the funds expended to meet the prescribed objectives of this project were $60,784.13 (see Appendix A) The grant was overspent to the amount of $506.13. This cost was absorbed by the School of Health Sciences.

6: Introduction
The Interactive e-Atlas (ieA) had its genesis five years ago as a tool to support the often difficult and demanding requirements of learning and teaching in the health care fields. It was developed as a collaborative project across two schools and five disciplines and, in line with advances in learning technology, is based on simple yet flexible and robust Information Technology software. The ieA has been developed to assist students to link the difficult and often counterintuitive concepts associated with anatomical constructs, physiological functioning, radiographic imaging studies and discipline-specific knowledge.

The architecture is based on a series of ieA pages linked sequentially. Each page has the same basic structure with an image of interest that can be investigated in an interactive way. A structural term in the menu can be clicked to reveal a subdivision of the image or cursor movement over the image will indicate the name of the structure. Maintaining a similar interface ensures a reduction in cognitive load as students can navigate within the established structure and thus focus on content and pedagogical issues.

Conceptual Framework for the ieA

[Diagram showing the conceptual framework for the ieA]
There is a menu on each page of the IeA module which includes. Once the student has finished with a page they can move to the next page (or select any other page). Basic functional information is provided for each structure selected in an image. More detailed information about each structure is provided (as required) by links from each page.

Exemplar of the Menu to guide students

7: Detailed project description

Whilst the formative version of the IeA focused on brain structure and function, this grant sought to enable the expansion of the learning tool in the following dimensions:

- Extension of the IeA modules for different areas of anatomy and physiology
- Addition of a student assessment and feedback tool
- Development of an IeA Academic Tool Box.

These goals were met as will be identified in the following documentation.

7.1: Overview of expertise sourced throughout the project:

Given the detailed nature of the project, the following expertise was sourced throughout its lifecycle:

- Stuart Whitman was accessed re: the requirements for the life of the grant.
- Peter Czech was contacted to ensure that the project plan and Excel spreadsheet were acceptable. Peter also approved a slight variation to the initial grant proposal to enable the provision of $5,000.00 for project support funding.
Meetings were held with George Fernandes, Tim O’Connor and Gary Fitzgerald regarding the needs of the platform to link with weblearn.

A meeting was held with Gary Allen regarding IT requirements.

Annie Lennox advised throughout the life of the grant regarding copyright requirements.

Discussion continues re patenting and trademarking requirements; initially with Professor Jim Barber and subsequently with Mark Littlejohn. A business case regarding this matter has been put to Mark for discussion at a university level.

Meetings were held with Bill Lane from the Educational Media Group regarding the “glass brain” project as well as a transfer of the IeA to hand held technology.

The IeA team continues to meet with relevant staff within the university to meet the ever expanding needs of the developing learning tool.

7.2: Educational Theoretical Foundation and Pedagogical Underpinnings

The educational theory underpinning the IeA learning tool is adapted from Kirkpatrick’s (1979) Training Evaluation Model. Kirkpatrick’s Model is foundational in providing a rigorous framework to enable the evaluation of knowledge acquisition and implementation, and sits well within the clinical transfer of knowledge undertaken within nursing practice. The Kirkpatrick evaluation model has four levels:

1. Reaction of student - what they thought and felt about the training
2. Learning - the resulting increase in knowledge or capability
3. Behaviour - extent of behaviour and capability improvement and implementation/application
4. Results - the effects on the business or environment resulting from the trainees performance

(Kirkpatrick 1979)

Levels one and two (reaction and learning) are typically measured as an outcome of teaching and learning within the academic environment. Level three and four (behaviour and outcome) are measures of knowledge transference to the clinical area for measurable and quantifiable outcome improvements. Level three reviews whether the student has “put their learning into effect” in their employment in a sustained way, and level four reviews “quantifiable aspects of organisational performance.”

7.2.1: Principles of Pedagogy - Learning and Teaching

The IeA learning tool is based on the following educationally sound pedagogical framework:

1. The IeA architecture is as simple as possible for the student to use
2. The module size is kept to a minimum (normally a maximum of 10 pages)
3. Learning objectives are provided at the beginning of a module
4. Images are used as the basic element - this is in keeping with the general preference of students for visual information (over written / verbal) as identified in many different disciplines but particularly so for anatomical material.

5. The learning task is interactive.

6. Only the core information is provided at this level.

7. Links to further information are given to provide an adaptive learning experience (i.e. the student can choose to follow specified pathways).

7.3: Enhancement of Existing IeA module:

As identified earlier the module initially developed covered the brain in three dimensions.

7.3.1: Brain Module:

**Gross Anatomy of the Brain:**

Gross Anatomy with highlighted section in red.

**Sectional Anatomy of the Brain**

Sectional Anatomy with area / structure of interest highlighted in blue.
Neural Pathways within the brain.

Exemplar of Visual Pathway highlighted red, orange, white and green.

The three “screen shots” demonstrated above indicate the capacity of the leA to allow the students to select specific areas / structures; have them areas identified on the menu to the right of the image and for text to be displayed to provide information regarding the highlighted area / structure. These capacities can be used interchangeably enabling students to rehearse and confirm knowledge acquisition.

Overview of the dimensions of the screen view.

Discipline-specific buttons allow students to review discipline-specific areas of learning or expand learning opportunities by sharing in the learning requirements for other disciplines.
7.3.2: Addition of Radiographic Imaging

The addition of radiographic images, aligned with the relevant anatomical area of the body enables the clinical visualisation of the relevant body area to enable skill development and enhancement in this area. Provision of radiographic images were negotiated and provided through industry partnerships and RMIT has been given copyright approval to utilise them. The copyright approval has been co-ordinated and overseen by Ms Annie Lennox from RMIT copyright service.

Currently copyright is held from the following Industry partners

- John Hunter Hospital
- Royal Melbourne Hospital
- The Brain Research Institute - Austin Health
- Florey Neuroscience Institute
- Austin Health
- Monash Medical Centre
- St Vincent’s Hospital
- Box Hill Hospital
- Western Hospital
- Symbion Imaging – Knox Hospital

The participation of industry partners is ongoing and Ms Annie Lennox from RMIT copyright continues to ensure that legal and contractual arrangements are met within the constructs of this process.

Acquisition of radiographic images requirement is currently being expanded to include a broad range of images (derived via various techniques) from all body areas. The collaboration and contribution of industry partners in this regard cannot be overstated.

An exemplar of radiographic imaging linked to the IeA modules.
7.3.3: Three Dimensional Rotational Imagery.

OSIRIX software and associated techniques were employed, and the leA team has been able to produce innovative “fly through” images of the head and brain from the aspect of the sagittal, horizontal and coronal planes. Approval was first obtained from the software provider. This application allows the demonstration of the anatomical and functional relationship between structures in different parts of the cranial vault. The resulting images were produced by “re-assembling” CT images using the OSIRIX software. The speed at which the image assemble or disassemble through all levels can be manipulated.

An example of a sagittal “fly through” of the head and brain using OSIRIX software. (note OSIRIX trademark bottom right hand corner of screen)

Building on this concept the Educational Media Group led by Bill Lane has developed a “transparent brain” that allows the demonstration of neural pathways through three dimensional brain substance. As identified below the pathways and structures are shown in different colours;

- Pathways: auditory pathway – yellow; motor pathway- orange; pain pathway – blue; touch pathway – green and visual pathway – red
- Structures: ventricles – orange; thalamus – pink and internal capsules – blue.

Buttons allow rotation and zoom functions

Structures and pathways can be removed or added as required
Screen shot of the rotational transparent brain (still in development)
The orientation of the brain can be rotated by passing the cursor over the surface and “click and move.”

Inferior view of the rotational transparent brain.

7.3.4: Heart

Using the same pedagogical principles that have supported the development of the brain modules the grant allowed for the expansion of the iEA into other anatomical and functional areas.

The decision was made was to align cadaveric photographs of the body parts with the more frequently utilised plastic models to allow the student to orientate themselves to the specimen appropriately.

The screen “set out” throughout the modules remains consistent to facilitate orientation to the anatomical view. Highlighting of specific anatomical areas and landmarks also remain consistent as does the availability of the menu and text box information.

Screen shot of one page of the heart module

As with the OSIRIX capacities demonstrated using brain imagery, the project team have been able to reconstruct the heart into a 3 dimensional rotational model.
3 dimensional rotational version of the heart reconstructed from CT imagery.

Work with this technique continues.

7.3.5: Blood Vessels

Screen shot of one page of the blood vessel module

7.3.6: Respiratory System

Screen shot of one page of the respiratory system module
7.3.7: Nervous System – Spinal Cord

Screen shot of one page of the nervous system module showing the spinal cord

7.3.8: Nervous System – Nerves

Screen shot of one page of the nervous system module - nerves

7.3.9: Reproductive System

Screen shot of one page of the male and female reproductive system modules

Relevant radiographic images continue to be uploaded onto the leA platform.
In 2010 the IeA team will continue their work on the modules for

- Surface anatomy
- Musculoskeletal system
- Digestive system
- Urinary system

**7.4: Addition of a student assessment and feedback tool**

The current IeA has been integrated with the student assessment and feedback tool WebLearn. The integration of WebLearn multiple choice questions that are targeted to the IeA pages provide self-testing, and feedback to the student (text/diagrams) when the most appropriate answer is not selected. The WebLearn system provides randomized questions that serve to maintain student engagement with the IeA. Students not performing well at any point are encouraged to repeat the previous page and reassess their knowledge by accessing WebLearn again. Thus through “self-diagnosis” or by direct feedback from staff, students can return to the relevant section of the IeA, gaining valuable formative feedback on their progress.

[Diagram: Conceptual Framework for integration of WebLearn to the IeA platform.]

[Screen shot: Integrated WebLearn page demonstrating anatomical specimen with associated multiple choice questions.]
The WebLearn system can also be used to monitor student performance (e.g. most commonly “missed” questions) and the information used to modify the question databases and enhance feedback as appropriate.

The integration of WebLearn has formatively been assessed as a positive experience for the students. Further work will continue on this in 2010.

7.5: The evaluation framework used during and in the final stages of the project

The evaluation process undertaken over the life of this grant has been both formative and summative. It involved the following elements for review:

1. Ongoing assessment of student performance using the WebLearn system
2. End of semester evaluation using a survey form
3. End of semester evaluation using focus groups.
An extensive evaluation of the learning tool was undertaken in semester 2 2009. The evaluation exercise undertaken was ambitious and evaluated both

1: the ability to navigate within the Atlas
    and
2: the learning outcomes for the students.

This “process and outcome evaluation” was based on the successful evaluation methodology developed and used by Professor David Clarke at the University of Melbourne in his multinational studies on classroom learning through the International Centre for Classroom Research. Professor Clarke is a consultant on the current project and gave approval for his methodology to be used.

Ethical approval for the evaluation exercise was sought and obtained from the College Ethics Committee on 16th July 2009 with the following comments made:

4.1.4 BSSTAPP 38 – 09 PISANI The Interactive E-Atlas Strategic Implementation within a Health Science Program and Integration into the RMIT community

“The committee noted that the project team have appropriately addressed the ethical issues and considered this to be a Low Risk proposal (formerly Level 2).”

“I am pleased to inform you that the committee has approved your application for a period of 6 Months to January 2010 …..”

(Ethics approval letter 16/7/2009)

The evaluation process involved the Post Graduate Neuroscience Nursing students who answered three case study questions using the leA as a resource; they then answering nine multiple choice questions related to the case studies in question. Nine students were split into groups of two; eight of the students had used the leA during the semester and one student had not used the leA at all.

The case studies were not designed to test the students’ knowledge but to identify the ease (or otherwise) with which they were able to navigate the leA. The brain module only, was used, and the students took around 30-minutes to complete the case study exercise and multiple choice questions.

Students were video and audio taped using the “Screenflow system” on IMac computers. The Screenflow System allowed all verbal and non verbal expressions to be captured during the exercise.
An example of the Screenflow system capture.

Page of the IeA being used

Video of the “student” expressions

Timed audio of “student” comments

Screen shot of the evaluation screen used during data collection and analysis.

At the conclusion of the evaluation exercise the students were invited to review the evaluation exercise and comment on any “issues” they experienced at the time and were asked to make comments related to the learning tool. The audio and vision acted to prompt students to “re-live” the experience and to recall their feelings, concerns and issues at the time of the exercise.

The data from the students’ multiple choice examinations was also linked to the feedback provided to complete the outcome evaluation.

Whilst the data analysis is still being completed the outcomes appear to indicate

- Support for the IeA as a learning tool
- The need to provide a “search” function to enable easier and directed structure identification.

Separate to, but complimenting the formal evaluation process, the IeA has been presented at various conferences across the Commonwealth of Australia and introduced to international health professional audiences. Anecdotally there is significant support for the IeA and much interest in obtaining access to it from both academic and industry partners.
7.6: Development of an IeA Academic Tool Box.

To make the IeA available to any staff member regardless of discipline, the development of an Academic “Tool Box” was proposed in the 2009 grant application. The objective of the academic tool box was to allow any staff member to use a template module for the addition of images/text and assessment/feedback as relevant to other specialties.

This is one area of the proposal that has provided in many ways the most challenge for the IeA team. The realisation that the IT components require specific IT expertise has meant the redesign and reconstruction of the “toolbox”. This is currently underway and is anticipated to be completed in the short term.

8: Improved student learning experiences, outcomes and employment opportunities

The IeA has been formatively used in the Post Graduate Neuroscience Nursing Program in 2008 and 2009.

CES outcomes for that program (GC 089) are as follows:
- 2008 semester 1: GTS 71.2: OSI 75%
- 2008 semester 2: GTS 85.2: OSI 100%
- 2009 semester 1: GTS 82.8: OSI 80%

Post-graduate Neuroscience Nursing student comments related to this learning tool include the following:

- “established a good footing in the course”
- “good introduction for anatomy”
- “helpful for fast/quick reminder”

The following course co-ordinators have requested that they be allowed access to the IeA for 2010 to support their student learning activities:

NURS 2112 Health Assessment for Health Care Professional
NURS 1036 Critical Care Nursing 1
NURS 1037 Critical Care Nursing 2
NURS 2069 Professional Development in Critical Care nursing
NURS 1056 Advanced Nursing Technology
NURS 1033 Neuroscience Nursing Practice 1
NURS 1034 Neuroscience Nursing Practice 2
NURS 2067 Professional Development in Neuroscience Nursing
NURS 2115 Advanced Clinical Nursing Practice Stroke Management
NURS 1023 Primary Health and Assessment of the Young Child
NURS 1091 Clinical Issues for children and the Community
9: Innovation

The evolution of “hand held” technology is providing an opportunity for the project team to make this learning tool more flexible and transportable in a way not imagined at the genesis of the project.

Discussion is currently underway with the IT experts within the university to find the most appropriate way in which to display this learning tool. The IeA is presented using flash and flex with the text written in XML and an embedded HTML file. The considerations around whether iPod or ANDROID technology is preferable are related to the language in which the IeA is written. At this point in time Apple does not accommodate Flash programming however this may change in the future.

Other considerations relate to the size of the screen and discussion around whether a notebook computer might enable better image definition; how the IeA is to be made available to end users (via a web link; CD/DVD) and all associated considerations are currently under review.

In order to protect the intellectual property of RMIT University the project team are reliant on the expertise of Mark Littlejohn and advice is currently being sought in relation to patenting; licensing and registration. This work and these considerations are ongoing.

10: Strategic alignment to RMITVision 2010:

The IeA strategically aligns with all four (4) of the RMIT Vision statements and the following priority statements

Priority 2: Position RMIT as the first choice provider of work and industry relevant learning.
Priority 3: Develop focused areas of excellence in research and scholarship that reflect our global engagement with industries and communities.
Priority 4: Ensure flexible, useful pathways and learning opportunities for students
Priority 5: Create an experience for students which is stimulating and satisfying and which celebrates diversity
Priority 7: Develop facilities and systems to support and sustain excellence in education and research
10.1: Linking to a WIL Pedagogical Framework

The RMIT WIL objective is to produce work-ready graduates with a hunger for life-long learning. The leA has forged strong links with industry partners and across multiple disciplines within the academy and has enabled actualisation of a Work-integrated learning focus with a framework of Multi-Disciplinary Based Learning.

RMIT University has a proud history of its links to industry, and maintains a strong pedagogical focus on Work integrated Learning (WIL). Nowhere is this more apparent, nor indeed necessary than in the disciplines of the applied health professions. The continued development of the leA will provide the basis for future ARC linkage grant applications in association with industry partners in nursing and medical imaging to further demonstrate the strong links with the Work Integrated Learning focus of the applied health professions.

10.2: Student Engagement

The interactive and self paced design of the leA allows students to navigate the atlas in all of its dimensions at their own pace. The integration of Weblearn as a self assessment and feedback tool has reinforced the usefulness of this tool in the student learning experience.

11: University wide application

As discussed in the LTIF grant application submitted for the 2009 round of grant offers, the leA has application for any applied health field, however the platform has been designed to be purged of health information to enable other discipline related information to be added. The development of the leA “toolbox” supports this activity.

Our innovative leA has been shown to improve student learning experiences. The innovative architecture of the tool permits its strategic use within any part of RMIT University where images, diagrams or schematics can be used. Thus the leA has a University-wide application and, as it is simple, will not require a large infrastructure or support commitment. Compared to commercially available systems, the leA will have the advantage of being RMIT-owned and totally adaptable by the end-user. The leA is anticipated to assist staff in those areas where self-directed learning activities in specific programs need to be strengthened.

12: Value for money

Whilst there are a number of similar tools on the market, both conceptually and graphically, this tool brings with it a uniqueness that “brands” RMIT University and its discipline-specific knowledge. The linking of cadaveric anatomical specimens, radiographic images and discipline-specific knowledge, showcases RMIT University Programs through a flexible and user-friendly learning tool that is unlike anything currently available.
There are many benefits associated with the development and availability of the Interactive Electronic Atlas.

1: the anatomical content is wholly owned by RMIT University

2: the radiographic content is ceded to RMIT University by copyright release

3: the Discipline-specific content has been and is being developed by RMIT University.

4: the platform has been developed by RMIT University and is able to be adapted to other non-health-related disciplines. The current content can be “stripped” and new content (engineering, computing etc) can be loaded.

5: the program is being developed to be used with “ANDROID” hand held and/or other mobile technologies.

Recent discussions at conferences and fora locally, interstate and internationally have generated a great deal of interest in the Atlas. At an industry level, as well as within the academy there has been significant interest in the availability and flexibility of this tool. The marketing opportunities, at least from an anecdotal perspective, would seem to be extensive.

13: Dissemination of project outcomes; completed and planned.

It is the belief of the project team that the IeA should be widely available to support student learning. The current discussion is related to the protection of RMIT Intellectual Property through licensing; patenting or registration. The issues also concern the provision and upkeep of the IT infrastructure and content associated with the IeA. These elements are currently under consideration:

13.1: Developmental Oversight

The project team has developed the IeA to the point where the “end users” of the completed tool, will manipulate the content within the constructs of the technology. The Learning tool has been jointly developed by Disciplines within the School of Health Sciences and the School of Medical Sciences and this developmental ownership will continue. It is anticipated that interested staff within these Schools will continue oversight of the learning tool.

13.2: Maintenance of the Learning Tool:

The Marketing option selected will dictate the requirements associated with this matter. If the learning tool remains within the purview of RMIT University, then there will need to be an appropriate resource allocation for maintenance and support. If it is provided as a “one-off” purchase, these costs will be redundant.
13.3: Intellectual Property Position

As identified earlier, the intellectual property is owned by RMIT University. The IT platform was developed by the project web developer, the cadaveric images were photographed and prepared by members of the project team and the Educational Media Group (Margund Sallowski) and the radiographic images have been sourced from industry partners with appropriate copyright release as directed by the RMIT copyright office.

13.4: Risk Assessment

Given the nature of the IeA a comprehensive risk assessment has not been undertaken for the IeA prior to distribution. This will be revisited if deemed necessary.

13.4.1: Operational Risk:

The RMIT Ethics committee and Privacy Officer were both contacted in 2009 to ensure that there were no ethical or privacy concerns related to the cadaveric images being used for this tool. No issues were identified.

Issues related to future operational maintenance will depend largely upon the marketing option selected based upon expert advice.

13.4.2: Financial Risk:

The project team is not aware of any financial risk associated with this learning tool.

13.4.3: Legal Risk:

The project team is not aware of any legal impediments associated with this learning tool. We will ask the RMIT legal team to review prior to launching.

13.4.4: Human Resources Implications:

As identified previously, the human resource implications will entirely depend upon the marketing option selected. The major risk factor associated with this will be the inadequate allocation of funding to support the learning tool.

13.4.5: Market Risk:

The project team foresees no market risk factors associated with the distribution of this tool.

13.4.6: Technological Risk:

The technological risk factors will be dependent once again upon the marketing strategy identified.
14: Summary of the project, outcomes, impacts and dissemination

The Interactive Electronic Atlas (IeA) (2004) is designed to provide students with a self-paced multi-dimensional learning tool to support and guide self-directed learning. The IeA uses photographic images from the cadaveric laboratory and medical imaging studies to provide a multi-layered platform for presentation of discipline-specific knowledge. The IeA allows for self-paced navigation across modules, feedback and evaluation using a linked student feedback tool and knowledge extension through the provision of the ability to access additional information.

Reference:
Kirkpatrick’s learning and teaching evaluation model - the four levels of learning evaluation
http://www.businessballs.com/kirkpatickevaluationmodel.htm
[accessed 22/06/2009]
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Program Support Spending Costs

Attached to IeA researcher
Cumulative amount spent
Cumulative amount remaining

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<td>$367.90</td>
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**IT Consultancy**

- Weblearn 128 hrs at $100/hr + oncosts = $115.81
- Cathy Leahy (1/4/09-10/6/09)
- Academic Toolbox 64 hrs at $100/hr + oncosts = $115.81

<table>
<thead>
<tr>
<th>CC</th>
<th>Grant Money</th>
<th>Replacement teaching</th>
<th>Evaluation</th>
<th>Academic Toolbox</th>
<th>Program support Spending</th>
<th>Attached to IeA researcher</th>
<th>Cumulative amount spent</th>
<th>Cumulative amount remaining</th>
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<td>$14,327.27</td>
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**Total to date** $54,741.22

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<tr>
<th>Ethics preparation</th>
<th>Program Support Spending Costs</th>
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<td>$1,227.60 Lara Stevens 36 X $34.10</td>
<td>Video Quad Processors $455.85 Heather R Pisani</td>
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<td>Screenflow Licence $165 Tom Molyneux</td>
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<td>O'SRIIX site licence $386.92 all the team</td>
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