The Liggins Institute
An Institute of The University of Auckland

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND
Te Whare Wānanga o Tāmaki Makaurau

The Liggins Education Network for Science

Bringing Schools and Scientists Together

Scientists in High School Classrooms via Interactive Television

Initial Post Trial Report

Presented to the University of Auckland Information Technology Conference

ITCONF08 November 27, 2008

Jacquie L. Bay[1]†; Deborah M. Sloboda[1]; Jo. K Perry[1]; Peter E. Lobie[1] ; Robert Hamilton[2]; Michael Keefe[3]; Helen A. Mora[1]; Jane Campbell[4]; Peter D Gluckman[1]

Please note that final evaluations are still being collected. A full and final paper relating to this work will be published in early 2009.

Exploration of the use of ICT's to provide effective teaching and learning experiences is a key goal for Liggins Education Network for Science. Specifically, it is envisaged that ICT's may provide a mechanism by which students from a range of geographic locations could be brought together for seminars designed to provide learning extension opportunities, and simultaneously increase student awareness of the work of NZ scientists. Following a concept trial in 2007 using simple data conferencing technology, a further concept trial using either interactive satellite television or multicast technology was launched in 2008. The results of these trials have shown that the concept of bringing students from a wide range of schools together for advanced seminars linked directly to the NZ curriculum and NZ national assessments is well received by both students and teachers; that communication of concepts to the student is most effective when pre-seminar readings are written by teachers in consultation with scientists, and seminar presentation is shared by teacher and scientist; that scientists appreciate the opportunity to communicate in this way with secondary students; that satellite television technology with interactivity via wiki, Skype room and telephone bridge provided effective communication for participant schools from a wide range of geographic locations both rural and urban, independent of the level of broadband capability in the school.

[1] Liggins Institute, National Research Centre for Growth and Development, University of Auckland
[2] Information Technology Services division, University of Auckland
[3] Kordia™

†Author correspondence E-mail: j.bay@auckland.ac.nz

[4] RSNZ Teacher Fellow, Avondale College: Hosted by the Liggins Institute, University of Auckland

Science as an understanding of the natural and physical world, based on concepts of evidence is central to 21st century life. It underpins the well being of NZ communities through its relationship to resource provision and management, health and well being, sustainability, technological development and the economy. While provision of education for scientific literacy is essential and often dominates school science and curriculum debate, married with this must be opportunities through school science for the development of interest and understanding in students who have the potential to be future leaders in science. The NZ Scholarship examinations offer one such an opportunity, providing a robust academic challenge for high achieving students. Approximately 3% of NZ students studying Biology at NCEA Level 3 are awarded Scholarship and approximately 0.3% are awarded Outstanding Scholarship.

Schools offer learning experiences to develop the skills and understanding required for the Scholarship examinations via a combination of standard Year 13 teaching programmes and voluntary extension programmes run outside class time. Extension learning experiences for these students should ideally be contextualised in current scientific research and encourage discussion around links between the issues arising in the context, core concepts of science, the research process, research findings and their interpretation. In biology this typically involves students being exposed to current research articles, or preferably articles written specifically for 16 – 18 year olds based on current research. The learning opportunities provided for extension of scholarship level students are also valuable to the larger percentage of students (approx 18%) who reach merit/excellence achievement levels in the NZQA NCEA Level 3 examinations. A major challenge for schools relates to both the time required to develop these types of resources and access for teachers to academic journals. Additionally, small schools are faced with class sizes that make robust academic discussion at the highest level challenging when less that 4% of all students in NZ are expected to be performing at this level.

We hypothesised that specialist secondary teachers based within a university, with relevant pedagogical content knowledge and access to current scientific research, could use e-technologies to develop a programme which would address issues arising in the provision of meaningful learning experiences for high ability biology students in NZ schools. This involved a combination of programmes which were used to test the efficacy of the concept over a period of two years within the Liggins Education Network for Science[1]. The project comprised of five major components: (i) development of student reading modules linking current research to concepts in Level 8 of the NZ Curriculum and designed for students at the top end of the academic spectrum; (ii) professional development for teachers relating to the research being used in the student modules; (iii) trial of student reading modules of this type in schools and in the LENS classroom programmes; (iv) professional development for scientists to enable understanding of the school curriculum and appropriate teaching styles, leading to the development and trail of seminar presentations co-presented by teacher and scientist; (v)development and trial of the use of e-technologies to deliver the integrated learning package of student reading, seminar, student-teacher-scientist interaction via questioning, post seminar discussion via wiki.

The concept of development of interactive learning activities for students that linked schools with scientists via e-learning was explored to meet a number of significant learning equity issues in NZ schools. As already stated, development of learning resources contextualised in current scientific research, while known by teachers to provide effective learning opportunities, presents major issues in all schools due to the lack of teacher time for development, lack of access to scientific journals other than possibly New Scientist, and lack of direct access to scientists. This is compounded by the lack of common resources provided for NZ schools linked to NZ science. Issues relating to the potential for teachers to offer this level of learning experience are compounded in small schools. The ability of teachers to produce resources becomes exponentially difficult when only one teacher in the school is responsible for all biology courses. While cluster groups are used well by some teachers to address these issues, lack of access to journals and scientists is not resolved. Schools where the student cohort numbers are small also face issues around development of robust discussion in class. 18% of NZ students achieve at merit /excellence level in Y13 Biology and 3% achieve at Scholarship level. While 18% of a cohort of 120 in a school such as Auckland's Avondale College presents a good group size in which robust discussion can be developed, in a school such a Kaitaia College with a Y13 Biology cohort of 6, students who are performing at high academic levels are less likely to have peers performing at similar levels and therefore may lack the experience of robust academic discussion in a peer group. Even in an average sized urban school with a Y13 biology cohort of 20 – 30 students, there is typically only going to be 1 student working at this very top academic level and potentially 4-5 working consistently at the merit / excellence level. The delivery of interactive learning experiences via ICT's has the potential to address some of these issues and support teaching and learning in NZ schools.

Learning modules were designed in contextualised format making links between issues in society (relevance of science / capture of student interest), the science and concepts in the curriculum. Development of understanding of the nature of science underpinned each module via exposure of students within the readings to concepts relating to development of scientific evidence and theory. Scaffolding of concept development within each module moved students from concept reinforcement to extension. Details of the learning materials can be found in the supporting on line material (SOM)[2].

The contexts for modules 1 and 2 were trialled extensively in teaching programmes involving Year 13 students within the LENS classroom programmes by the teacher author. Additionally early versions of the student readings were trialled in secondary school settings by teachers who had attended professional development relating to the scientific research reported in these modules. This included seminar presentations, discussion of the research and access to relevant academic papers. Feedback from these trials established that the contexts were of interest to Year 13 students, provided suitable links to curriculum concepts which allowed development of understanding, provided extension opportunities for more able students and were written at a literacy level that was appropriate for Year 13 students aiming at achieving at a minimum of merit level in NCEA Level 3 examinations.

Learning Modules and Curriculum Links:

Module	Curriculum Concepts	Contexts
1. Feast or Famine	Gene Expression Processes of Evolution Nature of Science	Developmental Programming / Early Puberty / Adult Disease
2. Breast Cancer & Biotechnology	Molecular Genetics Mutations Applications of Biotechnology Nature of Science	Breast Cancer
3. Walking Upright: The Cost of Human Evolution	Processes of Evolution Trends in Human Evolution Nature of Science	Social interaction Technological Development Reproductive Costs

The key scientists involved in the programme were fully briefed on the NZ curriculum, learning outcomes expected in Year 13 biology courses, assessment expectations of both NCEA Level 3 Biology and NZ Scholarship Biology, and appropriate teaching strategies for Year 13 students. They all had significant experience of interaction with Year 13 students and teachers during the two year period that led up to the final television trial. This involved a combination of observation of teaching by specialist secondary teachers, small group interaction with students in secondary classes within the Liggins Institute, teaching to secondary students via seminars developed in conjunction with teachers, and conference / symposia presentations for teachers. Informal reflective critique discussions between the scientists and teachers based at the Liggins Institute were used during this time.

The core of the learning module design has been consistent throughout the two year trial period. A seminar paper is pre-distributed to schools, the seminar is presented with both live and remote audiences participating, and post seminar discussion opportunity is provided. During the period of the trial the following amendments were made to the format: co-presentation by teacher and scientist was initiated to improve concept links and add teaching relative to the construction of extended answers; students were provided with a list of core concepts from the Y13 biology programme and advised to review these prior to the seminar; post seminar challenge questions that supported student preparation for external examinations were provided; a wiki site was developed to allow students easy access to resources and provide a means by which students from participant school could connect in post-seminar discussion and potentially post-seminar learning activities. The addition of structured pre-seminar discussion questions for schools and professional development for all participant teachers (approx 50% only in 1st trials) will be provided in the next phase of the trial.

The pilot programme in 2007 involved the delivery of one seminar (module 2 version 1) on two different occasions. Twelve schools ranging geographically from the West Coast of the South Island to Auckland participated with a live audience of students from local Auckland schools. SMART Bridgit Conferencing Software, supplied by Manzana NZ, in conjunction with a teleconference, was used to link schools with the seminar. Connection trials were held with all schools in advance of the seminars and showed that dependent on the time of day, in some schools there were delay issues upwards of 2-4 minutes. This was identified as an issue relating to the contrast in upload and download speeds between the participant schools and the university. Trials between computers within university networks at similar bandwidth speeds were found to be faultless. Web cameras were removed from the setup to reduce the delay and while in some schools there was a constant and good delivery of the data conference, others found that delays were extensive. Despite the technological issues all participant schools reported that they would like to see the programme developed and would be interested in participating in further trials.

Evidence from a related LENS project which use web-casting to deliver lectures by international scientists to NZ schools identified that even with high quality web-cast designed to broadcast to networks that may only have bandwidth equivalent of home broadband, a small number of schools experienced issues relating to delayed and disrupted connections. This confirmed for us that any form of web-casting was likely to produce significant issues while for participant schools.

Using this evidence, a system of delivery was developed by University of Auckland Information Technology Services division and Kordia™that overcame these issues. The system used Kordia™'s content services, linking and satellite technology in combination with Telephone Bridge, Skype chat room and a wiki site provided by the University of Auckland. The seminars were produced by VoltTV Productions and broadcast to five secondary schools in a range of geographic locations, both urban and rural. In addition, the broadcasts were transmitted to two schools in Wellington via the KAREN network (currently accessible to < 12 NZ secondary schools). Schools receiving the broadcast via satellite were supplied with a set-top box and satellite dish. Each school supplied a television (most connected these to data projectors for large screen viewing), phone line and computer to access Skype and the

wiki. Anonymous questionnaires combined with observation were used to analyse the efficacy of the trial. Questionnaires specific to students, teachers and IT technicians were completed after each of the 3 seminars. A final questionnaire for students was posted out after the NZQA examinations.

Evaluation:

Interest and Uptake by Schools

The trial, although conceptually developed over a period of two years, came to fruition at very short notice. Schools were advised of the potential to participate only 3 weeks in advance of the trial which was held during the 4 weeks prior to national examinations in NZ schools. The five schools that were approached to form the remote audience in the trial all had connections to LENS either with classroom programmes, web casts or teacher PD. The students in three of these schools had experienced a classroom programme at the Liggins Institute that linked into aspects of the context used in seminar 1. The teachers in these schools had all attended professional development relating to this research. One of the Auckland schools in the remote audience group had also participated in the 2007 seminar trial and had experienced more problems than any other school in receiving those broadcasts. Two of the remote schools requested that they invite other secondary schools from their region to gather with them to participate in these broadcasts. An additional 8 schools, some travelling for up to 90 minutes to reach the venue, gathered at these schools to participate. Seven schools geographically close to the Liggins Institute formed the live audience. Each of these schools had a prior relationship with the institute. Students had all experienced teaching programmes based around aspects of the context used in seminar 1 and all teachers had attended teacher professional development linking this research to the school curriculum. The prior relationships between the participant schools and LENS may have influenced their decision to take part in the programme.

In the week prior to the first broadcast REANZ advised the project team that a small number of schools had been connected to the National Education Network (NEN-KAREN). Three schools with which the project leader had collegial connections were approached to observe the first seminar at this very short notice. Two of the three schools were not aware that they were connected to the NEN, the third, a school who had participated in previous LENS web-casts organised with one days notice students to participate. The second school activated their NEN connection that week, organised students to watch the recording of the 1st seminar and invited a further Wellington school to participate with their students in seminars 2 and 3. The third school did not participate. Schools connecting via NEN were not part of the evaluation as this connection was not expected to be available.

Approximately 75 students from local schools made up the live audience while a further 200 students participated remotely. Between 100 and 130 students chose to participate in the questionnaires. The willingness of schools to participate at short notice in this trial is indicative of the value that teachers see in this programme.

Participants

A range of schools from large urban to small rural participated. The analysis of participants in the questionnaire (Figs 1 – 3) suggests that those students choosing to participate in the questionnaire created a representative group in terms of school size and location. The ethnic distribution in the sample is not representative of the NZ student cohort, lacking significant Pasifika representation and having a lower than desired Māori participation. These two groups are underrepresented in science cohorts at Y13 in NZ schools. The large proportion of females in the group resulted from a dominance of large single sex girls' schools geographically very close to the Liggins Institute who comprised the majority of the live audience. 85% of participants intend to enrol in science courses at university on leaving school.

Fig 1: School Type of Students Responding to Questionairre

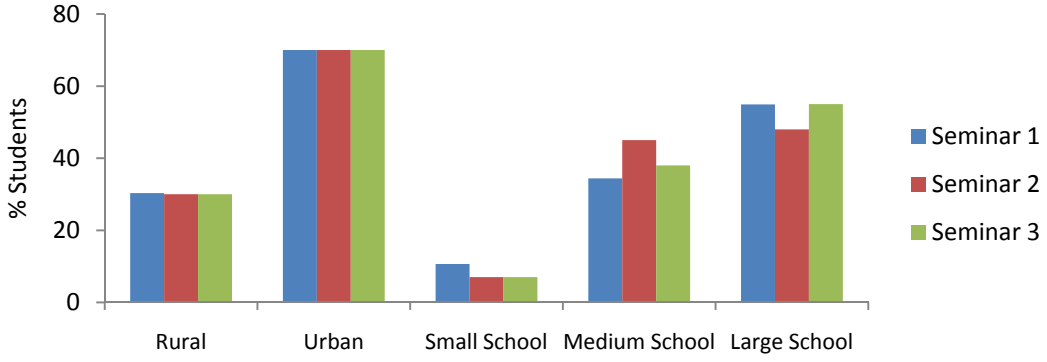


Fig 2: Ethnicity of Student Population Responding to Questionairre

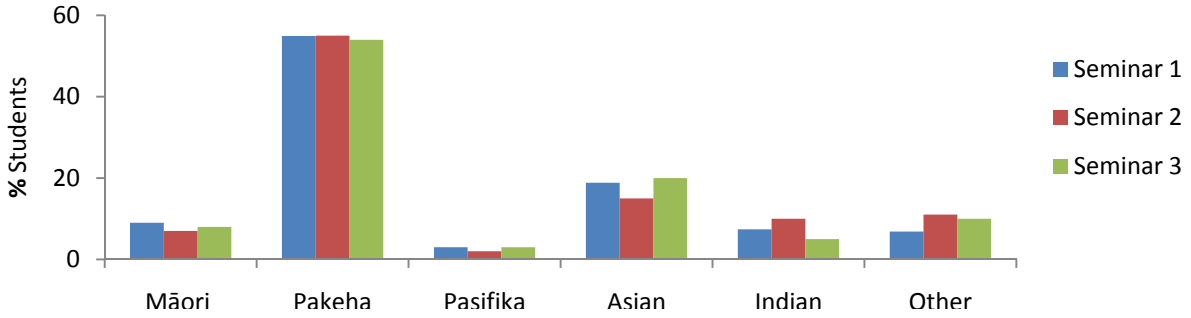
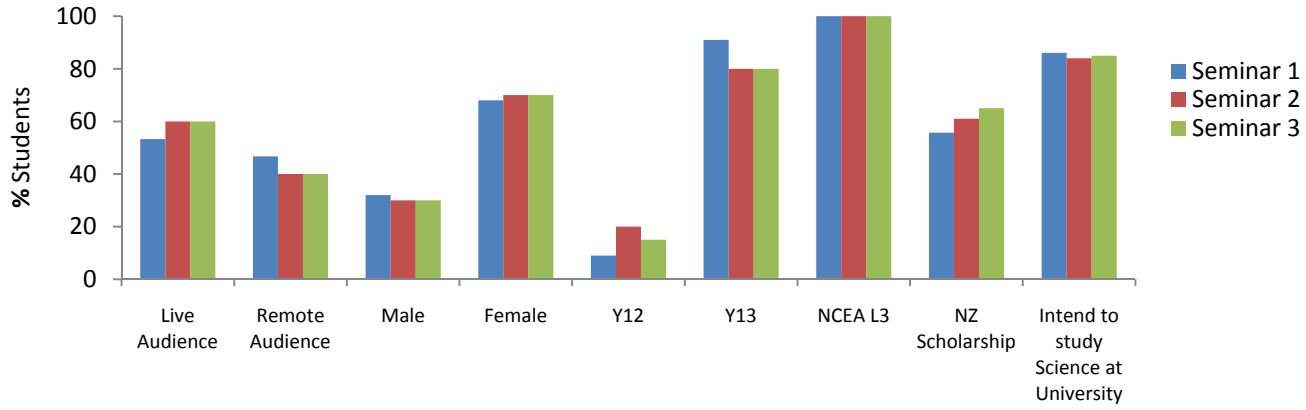


Fig 3: Participant Student Population Responding to Questionairre



Technical quality and connectivity

IT technicians or teachers with that responsibility were questioned about the ability to connect and equipment required for the satellite broadcast. No major difficulties were reported. Participating students and teachers also reported on technical aspects of the seminar. All groups noted the problems associated with sound through the phone links to schools. This issue relates to sound feedback and could be resolved in the future. Teachers and IT technicians suggested that the Skype chat room provided a good mechanism for questioning during the seminar. Responses indicated that they believed this to be both technically effective and a more comfortable mechanism for students to use.

Fig 4: % Students ranking technical aspects of the presentaiton as "Good" or better

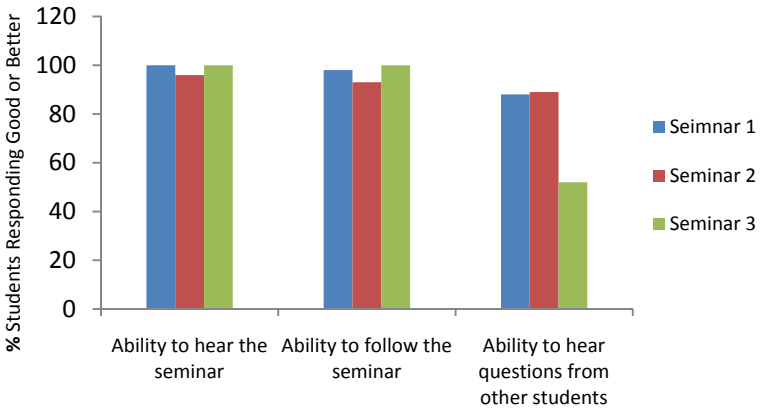
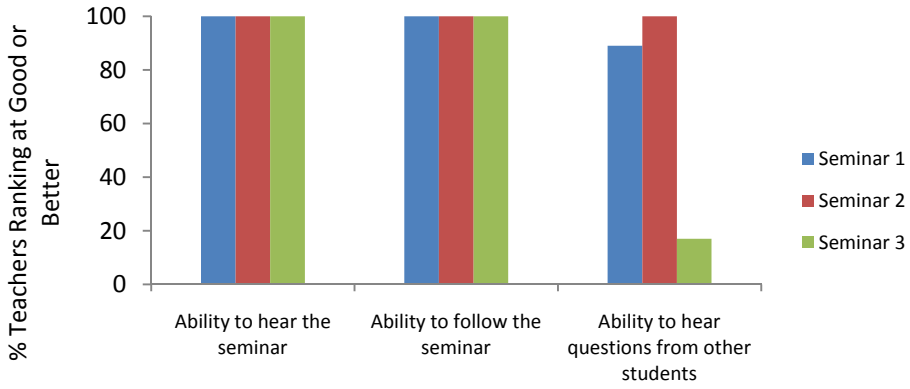


Fig 5: % Teachers Ranking Aspects of the Presentation as Good or Better



Value and relevance of the learning experiences

Both students and teachers indicated that they valued the learning experiences offered. The project team acknowledge that the tight time frame resulted in inadequate time in some cases for pre-reading to occur. This would be addressed in a full trial which would run over a period of a year and included a more formal pre-seminar programme that would be undertaken in schools involving pre-reading and focus questions. A likert scale was used to rank usefulness for learning. All participating schools indicated that they had valued the experience and would definitely participate in future programmes. 90% of students indicated that a programme such as this earlier in the year would have been beneficial to learning. Teachers noted that students were reluctant to ask questions initially and even in the 3rd seminar still found this difficult. Further trials will explore mechanisms by which student confidence to question can be developed. The pre-seminar focus questions planned for the next trial are one such mechanism. The technology choices of students will also be explored in this regard.

Fig 6: % Teachers Ranking Aspects of the Programme as Useful or Better

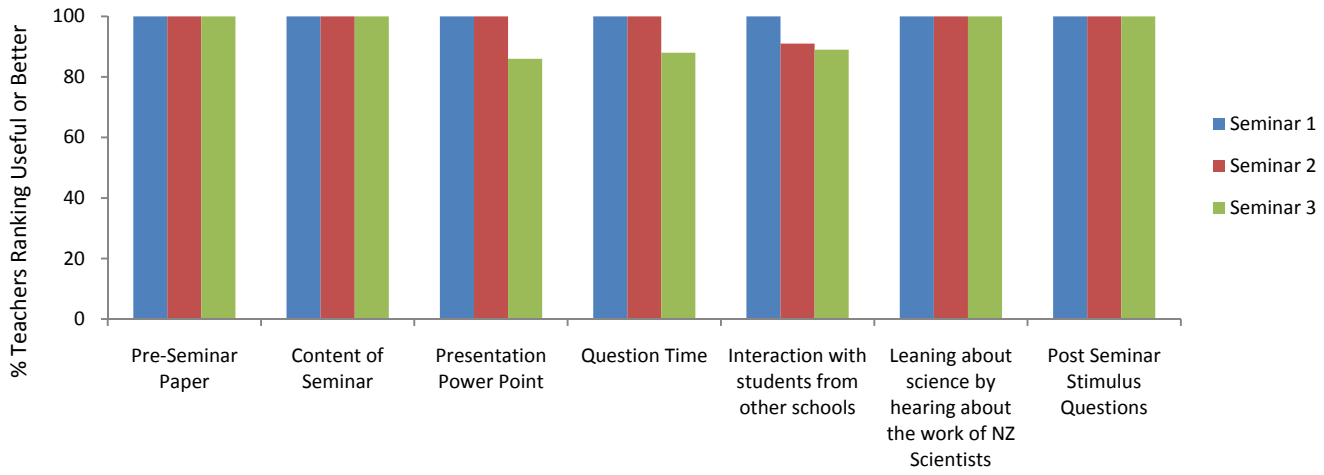
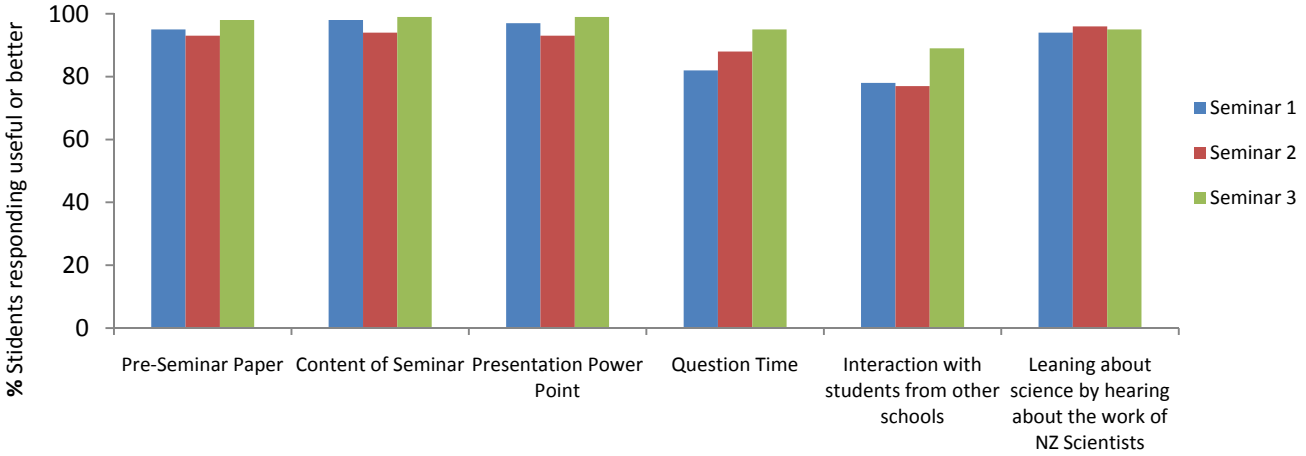


Fig 7: % Students Ranking Aspects of the Programme at "Useful" or better for learning

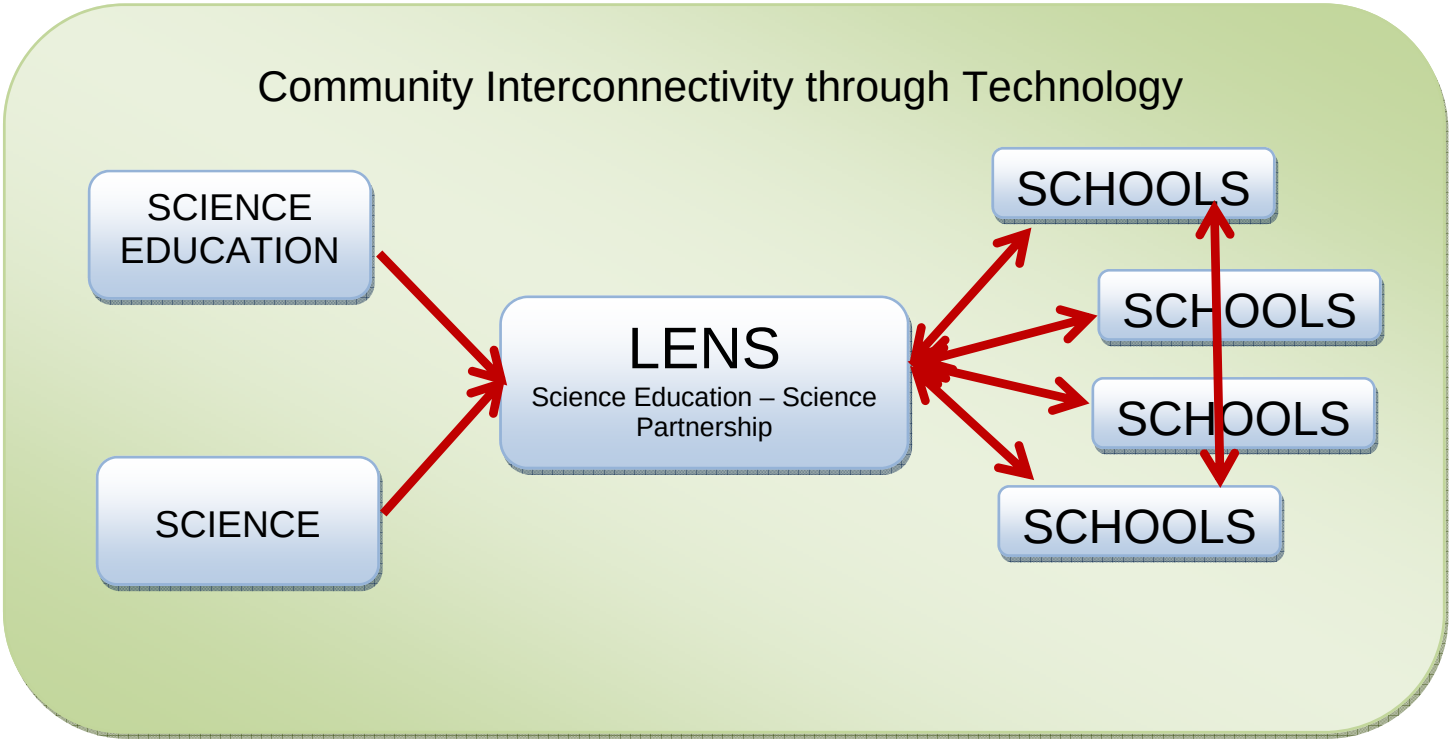


The wiki site was intended to increase accessibility for students to both scientists, teachers, and students from other schools. Feedback has indicated that the majority of students are not familiar with the use of this type of web site for collaborative learning. Students were not confident about logging in and editing the site. Despite this, 70 users became members of the site and a number added to discussion. The timing of the project during final examination preparation for students may have contributed to lack of active participation in the wiki. The next phase of the trial will involve exploration of scaffolded discussion questions and the use of a more user-friendly wiki writing system.

Relevance and Transferability

The project set out to find a mechanism by which academically able students could interact with scientists and other students in a contextual learning experience. The model of collaboration between teacher and scientist in development and delivery of learning programmes has been shown to be effective. The addition of a strong relationship with teachers in the school and teachers within the University is beneficial and will be developed further in future trials. The technological solution developed has demonstrated that the use of satellite television can alleviate the problems arising from access to adequate bandwidth in many schools. Parallel to this, the trial through the National Education Network has demonstrated that if all schools were connected to KAREN via the National Education Network, this would also provide a suitable delivery mechanism. Further development of the use of a wiki could enhance the interconnectedness of the school communities in the project.

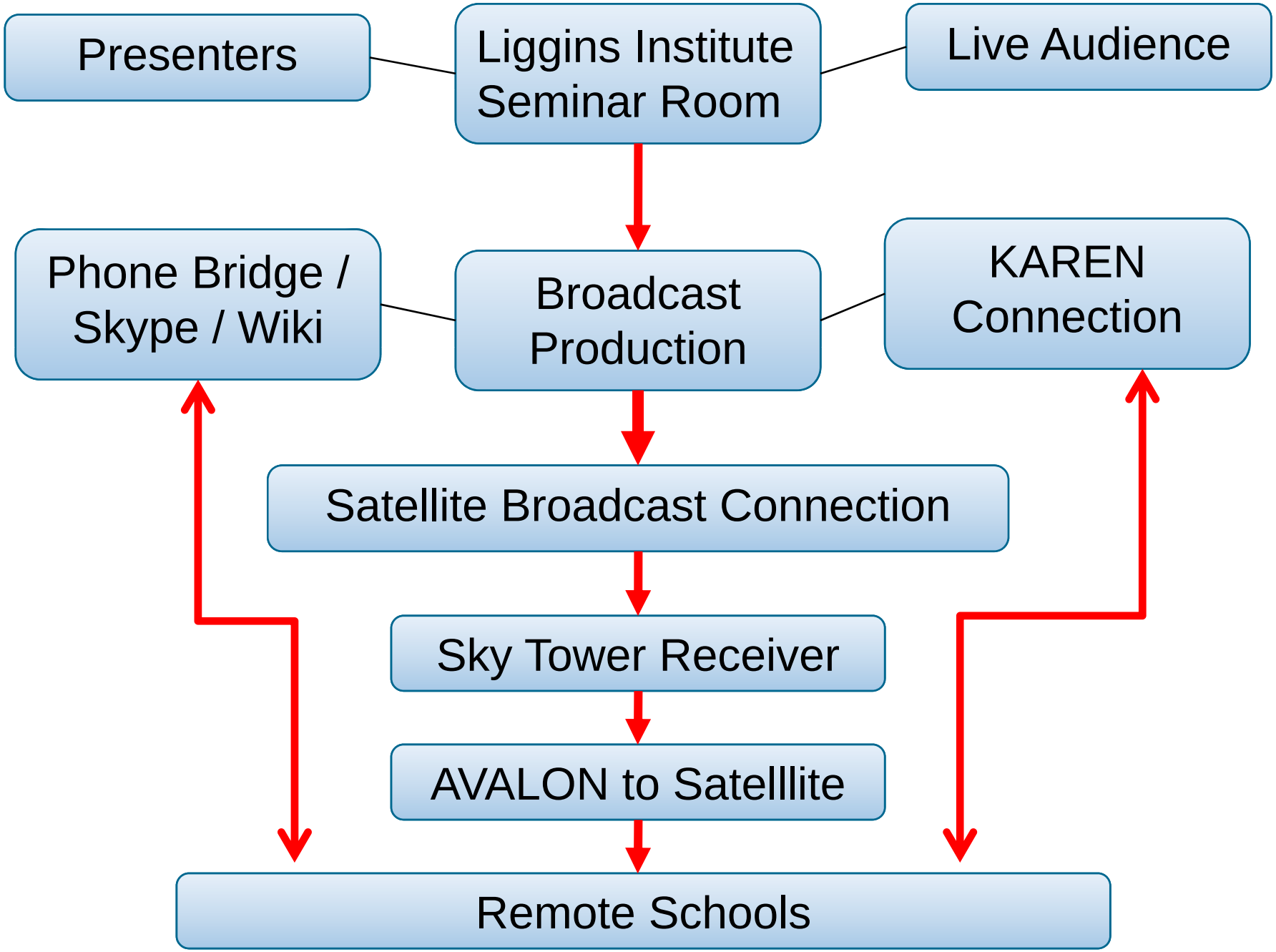
These concepts of connectivity and partnership between schools and universities or other related professionals are not limited to science. Experiences of this nature could be transferred to other learning areas, potentially enhancing conceptual understanding for students, offering teachers support and networking opportunities, and allowing students the opportunity to interact with a diverse range of people and communities within the context of learning; educational goals that are highlighted by the 2007 NZ curriculum. The technology is also transferable into more informal community learning settings where universities have a responsibility to engage with the community and share new findings which support the development of knowledge based societies. Similarly, the model could be used in provision of professional development opportunities for alumni of the university who like teachers, have a need to keep abreast with advances in knowledge and understanding.



[1] The Liggins Education Network for Science (LENS) is a secondary science education unit within the University of Auckland's Liggins Institute. LENS was formed in June 2006 to fulfil a vision of the Liggins Institute and NRCDG to provide effective links between secondary schools and scientific communities in the area of biomedical science. Learning modules are designed by collaboration between specialist secondary teachers and scientists, linked to the NZ curriculum and contextualised within current New Zealand science.

[2] Supporting Online Material http://lens.auckland.ac.nz

Acknowledgements:
Kordia™ Ltd; David Hedge and Emma Watkinson, VoltTV productions; Richard Naylor, R2.co.NZ; University of Auckland Schools Partnerships Office; MANZANA NZ Ltd
Felicia Low, NRCGD; Lynne Watson, Liggins Institute; Michal Stone, TEAM Solutions, University of Auckland; Stuart Braithwaite, HOD Science, Avondale College; Jean Grattan, HOD Science Otumoetai College; Bal Karan and Catherine Bartlett, Mt Roskill Grammar School; Sally Willock, HOD Science, Lytton High School; Gay Watson, Kaitai College; Alex Perry, Wellington East Girls' College; Matthew Easterbrook, Wellington High School
Dilworth School, Diocesan School for Girls, St Cuthbert's College, Epsom Girls' Grammar School, Auckland Girls' Grammar School, Auckland Boys' Grammar School, Sacred Heart College, Gisborne Boys' High School, Gisborne Girls' High School, Campion College, Katikati College, Bethlehem College Rotorua Lakes High School, Aquinas College


Presenters
Liggins Institute Seminar Room
Live Audience
Phone Bridge / Skype / Wiki
Broadcast Production
KAREN Connection
Satellite Broadcast Connection
Sky Tower Receiver
AVALON to Satelllite
Remote Schools