Unlocking Curious Minds: New Horizons Project, Final Report – Period to December 1st 2015

Section 1 – Unlocking Curious Minds Project Details

Lead Organisation	*Auckland University of Technology*
Contact person	*Associate Professor Frances Joseph and Associate Professor Sergiy Klymchuk*

Section 2a – Description of completed Project

Progress of the Project, including achievement against Project Tasks

Report for period to	*July – December 2015*
Key project highlights	• *Six workshops delivered between 15 August and 24 October* • *High level of engagement of participating students from South Auckland schools, with participant numbers ranging from a minimum of 45 to a maximum of 90 per session* • *Students introduced to a range of new technologies, from e-textiles to Motion Capture, to 3D Printing* • *Excellent questions asked by many participants showing curiosity and interest* • *Healthy competitive and collaborative environment during workshop activities* • *Publicity included Colab's July & August 2015 http://us4.campaign-archive2.com/?u=81c9110e4773e8b8027151dba&id=f555d69983* • *and September & October 2015 Newsletters (circulation 1200) http://us4.campaign-archive1.com/?u=81c9110e4773e8b8027151dba&id=ff14e0398c* • *STEM-TEC website announcements http://www.stemtec.aut.ac.nz/news-and-events/may-2015/28-may-2015-a-$19,000-grant-from-the-mbie-for-the-joint-project-with-co-lab* • *Documentation of workshops including video and photographic documentation (examples below):* http://www.stemtec.aut.ac.nz/news-and-events/2015-08/29-august-2015-workshop-numbers-dont-lie-or-do-they-maths-and-stats-for-high-school-students-from-south-auckland http://www.stemtec.aut.ac.nz/news-and-events/october-2015/10-october-2015-workshop-radical-engineering-answering-the-unanswerable-for-high-school-students-from-south-auckland

Section 2b – High level list of activities

A high level list of activities completed as part of the Project in chronological order

Date	Activity
15/August/2015	**Workshop 1: Wearable Technologies** A presentation about international projects, leading NZ wearable technology companies and AUTs Textile and Design Lab. Workshop on building fabric sensors by Associate Professor Frances Joseph and Charlotte Alexander supported by 2 MCT students (Hollee Fisher and Stacy Brett) who are also working in smart textiles research. 98% of the audience were girls. A very hands on workshop that introduced basic principles of electronics through making textile circuits. Link to photos: https://www.dropbox.com/sh/879iajeg53kughv/AAAgbFDkCB6hUWt7NitOkUmKa?dl=0
29/August/2015	**Workshop 2: Numbers don't lie or do they? Mathematics and Statistics** A panel of speakers from the School of Computer and Mathematical Sciences formed by Associate Professor Sergiy Klymchuk included Dr Sarah Marshall, Dr Robin Hankin and two postgraduate students. The participants were amazed by the power of numbers with funny puzzles, surprising paradoxes, stimulating provocations and subtle sophisms in maths and stats with some hands-on activities. In particular: a contest on solving tricky mathematical puzzles in different contexts – money, science, shape; a fun demo, engaging simulations and a popular video explaining the famous Monty Hall paradox in statistics; sharing professional experience of research in maths and stats on very important topics like climate change, pollution and ecology. Link to photos and video: http://www.stemtec.aut.ac.nz/news-and-events/2015-08/29-august-2015-workshop-numbers-dont-lie-or-do-they-maths-and-stats-for-high-school-students-from-south-auckland
5/Sept/2015	**Workshop 3: 3D Technologies** A presentation on the concepts and uses of 3D technologies including 3D Modelling, Printing and Motion Capture. This was followed by 3 workshops delivered by staff and PG students from the Schools of Engineering, Colab and Art and Design including: 3D printing and scanning technology demo's (Chris Whittington and Lisa Dreyer): Motion capture demo and engagement session including use of Mocap and VR technologies (Javier Estevez). Presentation of 3D programming and workshop on modelling in 3D by translating sound data into 3D forms and exploring these forms using VR technology Lab (Dr Stefan Marks assisted by BCT students). Link to photos: https://www.dropbox.com/sh/duazxrlqmks2n0b/AADZN2IGrsOMPnjRIOSWaIWma?dl=0
19/Sept/2015	**Workshop 4: Beyond our blue earth? Physics and Astronomy**

	A panel of speakers from AUT Institute for Radio Astronomy and Space Research formed by Director Professor Gulyaev and Jordan Alexander with support from a postgraduate student demonstrated the advances and frontiers in physics and astronomy with video demos and hands on activities modelling distances from planets in our Solar System on the desks and floor. Link to photos and video: http://www.stemtec.aut.ac.nz/news-and-events/september-2015/19-september-2015-workshop-beyond-our-blue-earth-physics-and-astronomy-for-high-school-students-from-south-auckland
10/Oct/2015	**Workshop 5: Radical Engineering: Answering the unanswerable.** Associate Professor David Wilson from the School of Engineering presented exciting features of engineering with videos, demos and individual and group hand-on activities. Examples include: building a wave machine using jelly babies and demo of flying quad copters outside. Link to photos and video: http://www.stemtec.aut.ac.nz/news-and-events/october-2015/10-october-2015-workshop-radical-engineering-answering-the-unanswerable-for-high-school-students-from-south-auckland
24/Oct/2015	**Workshop 6: What's in the cloud? Gaming & Artificial Intelligence** Steffan Hooper from the School of Computer and Mathematical Sciences with support from four AUT postgraduate students demonstrated the exciting features of artificial intelligence, internet-enabled applications and game programming. Example: the creation of a cloud-based multi-user game involving groups of students in the design and basic programming of a fun and challenging game. The participants had fun developing games using playing cards and dice and setting up and modifying rules for them. Link to photos and video: http://www.stemtec.aut.ac.nz/news-and-events/october-2015/24-october-2015-workshop-whats-in-the-cloud-gaming-and-artificial-intelligence-for-high-school-students-from-south-auckland

Repeat as required

Section 2c – Science activities

Science activities completed by the participants

Science activity	Description
Electronic textiles: Making soft circuits and fabric sensors	*Following an introduction to principals of electronics, students worked in pairs using special kits and how to instructions to build1) a simple sewn LED circuit and 2) a felted pressure sensor 3) a knitted stretch sensor and/or 4) a tit sensor. Students could link and test each sensor using the LED circuit.*
Understanding Motion Capture and Spatial data	*16 motion capture cameras were set up in a temporary space to form a 'capture area.' Through demonstration the principles and basics of motion*

	capture were presented and explained. Several demo tapes showing different Mocap projects were shown and discussed. The audience members were invited to participate using oculus rifts linked to the tracing system to explore a series of virtual spaces including a luxury yacht and a 'Star Wars Lightsabre' environment.
Exploring 3D scanning and printing processes	*Using physical samples and video demos, basic 3D modelling options were explained. Students were able to participate in making a 3D model by using a hand held scanner. Principals of 3D printing were explained and a small 3D was set up to print out a simple 3D form. Samples were given out to the students.*
Data translation: Designing 3D shapes using sound	*Following an introduction to basic principles of 3D representation and geometries, students worked in small teams to explore generating 3D forms through sound using software developed by Dr Marks. This included students singing in harmony, clapping and rapping. The dynamic shapes generated could be captured as snapshots. Each group then selected a favourite form, these were processed using a games engine and were then presented on an Oculus Rift so students could move around and explore the form as a 3 dimensional entity.*
Solving entertaining mathematical puzzles in different contexts: money, science, shape	*As described in section 2b with a link to photos and video provided*
Building Wave Machine with Jelly Babies	*As described in section 2b with a link to photos and video provided*
Flying Live Drone	*As described in section 2b with a link to photos and video provided*
Creating board games based on numbers with dice and playing cards	*As described in section 2b with a link to photos and video provided*
Simulations of the famous Monty Hall paradox in stats	*As described in section 2b with a link to photos and video provided*
Modelling distances from planets in our Solar System on the desks and floor	*As described in section 2b with a link to photos and video provided*

Repeat as required

Section 2d – Tools and resources

Tools and resources used to deliver the projects. Some examples may include school laboratories, university equipment, testing kits or recording devices.

Tools and resources	Description of use
E-textile Fabric Kit	*Charlotte Alexander designed and organised 4 types of kits for 1) making a simple sewn LED circuit 2) a felted pressure sensor 3) a knitted stretch sensor 4) a tit sensor. Each kit was made up of an instruction booklet, material, sewing tools and electronic components. These included LEDs, a battery and*

	battery holder, alligator clips, conductive thread, conductive fabric, felt, scissors, glue, paper templates, felt pens, conductive 'charm,' beads, conductive yarn, wool yarn, French knitter, awl. 30 kits were made for each project. Working in pairs the students made up and tested the various e-textile components by linking the sensors to the LED circuits with alligator clips. All groups made up at least three components in the 3 hour hands on part of the workshop, and many made up all four. Students were able to take home the booklets and the projects they had made. Information as to where to buy electronic components and 'maker' sites like Kokabant, which have information about making and programming e-textiles and step by step projects, were also given to students in a reference list.
Motion Capture Lab	*16 cameras, cables, computers, a Mocap suit and 'marked' accessories were taken from Colab City based professional Motion Capture Lab and set up in a classroom space on the Auckland South Campus. A Motion Capture area of approximately 2.5 x 2.5 metres was established, and the cameras linked to a computer and two demo screens so the audience could see what was being recorded by the cameras (as dot clouds) or the way this information could be mapped to characters or virtual spaces or what was being seen by a participant wearing VR technology (in this case an oculus rift). Students had the opportunity to both watch and to participate.*
3D Printer	*A 3D printer and hand held 3D scanner were set up in a space at South Campus. Students were able to see and use the scanner with one volunteer acting as a model and his or head being scanned. While this was taking place the process and principles of 3D data capture were discussed with the group. The 3D printer was used to demonstrate how an object is printed, layer by layer, and some 80 samples exemplifying more complex 3D forms were shown to the students. Many of these were given away as samples.*
Sound generated 3D shape software and VR demo	*Software developed by Dr Stefan Marks allows students to build 3D shapes and explore geometries using performative interfaces such a sound. Rendered through a games engine (Unity) these models are produced as 3D forms visualised by the participants in Virtual Reality with Oculus Rift*
Quad Copter	*A quad copter is a helicopter propelled by four rotors. Students were able to fly the quad copter in AUT south campus under supervision of Associate Professor David Wilson. The quad copter was used to demonstrate how drone is operated in real scenario and to capture images.*
Engineering material for wave machine	*Students created prototype of wave machine using rope, adhesive tapes, wooden skewers and marshmallow. The prototype demonstrates how students can use simple things to illustrate transverse wave motion in a visual and engaging manner.*

Section 2e – Science expertise

Details of science expertise used in the project, including the names, titles, expertise area and organisations of science professionals used (if any).

Scientist details	
Name	*Professor Sergei Gulyaev*
Title	*Professor*
Area of expertise	*Astrophysics and radio astronomy*
Employer	*AUT*
Field of research	*Please consult the scientist you worked with to obtain the relevant four digit ANZRC code*
ORC ID/Scopus Author ID	*Please consult the scientist you worked with to obtain these codes*
Scientist details	
Name	*Associate Professor David Wilson*
Title	*Associate Professor*
Area of expertise	*Electrical Engineering*
Employer	*AUT*
Field of research	*Please consult the scientist you worked with to obtain the relevant four digit ANZRC code*
ORC ID/Scopus Author ID	*Please consult the scientist you worked with to obtain these codes*
Scientist details	
Name	*Associate Professor Sergiy Klymchuk*
Title	*Associate Professor*
Area of expertise	*Applied mathematics and mathematics education*
Employer	*AUT*
Field of research	*Please consult the scientist you worked with to obtain the relevant four digit ANZRC code*
ORC ID/Scopus Author ID	*Please consult the scientist you worked with to obtain these codes*
Scientist details	
Name	*Associate Professor Frances Joseph*
Title	*Associate Professor*
Area of expertise	*Creative Technologies*
Employer	*AUT*
Field of research	*Please consult the scientist you worked with to obtain the relevant four digit ANZRC code*
ORC ID/Scopus Author ID	*Please consult the scientist you worked with to obtain these codes*
Scientist details	

Name	*Stefan Marks*
Title	*Dr*
Area of expertise	*Creative Technologies*
Employer	*AUT*
Field of research	*Please consult the scientist you worked with to obtain the relevant four digit ANZRC code*
ORC ID/Scopus Author ID	*Please consult the scientist you worked with to obtain these codes*
Scientist Detail	
Name	*Chris Whittington*
Title	
Area of Expertise	*Mechanical Engineering*
Employer	*AUT*
Field of Research	*Please consult the scientist you worked with to obtain the relevant four digit ANZRC code*
ORC ID/Scopus Author ID	*Please consult the scientist you worked with to obtain these codes*
Scientist details	
Name	*Dr Sarah Marshall*
Title	*Dr*
Area of expertise	*Statistics, analytics and statistics education*
Employer	*AUT*
Field of research	*Please consult the scientist you worked with to obtain the relevant four digit ANZRC code*
ORC ID/Scopus Author ID	*Please consult the scientist you worked with to obtain these codes*
Scientist details	
Name	*Jordan Alexander*
Title	
Area of expertise	*Astrophysics and radio astronomy*
Employer	*AUT*
Field of research	*Please consult the scientist you worked with to obtain the relevant four digit ANZRC code*
ORC ID/Scopus Author ID	*Please consult the scientist you worked with to obtain these codes*
Scientist details	
Name	*Steffan Hooper*
Title	
Area of expertise	*Computer games and artificial intelligence*
Employer	*AUT*

Field of research	*Please consult the scientist you worked with to obtain the relevant four digit ANZRC code*
ORC ID/Scopus Author ID	*Please consult the scientist you worked with to obtain these codes*
Scientist details	
Name	*Charlotte Alexander*
Title	
Area of Expertise	*Creative Technologies*
Employer	*AUT*
Field of research	*Please consult the scientist you worked with to obtain the relevant four digit ANZRC code*
Scientist details	
Scientist details	*Please consult the scientist you worked with to obtain these codes*
Name	*Dr Robin Hankin*
Title	*Dr*
Area of expertise	*Statistics*
Employer	*AUT*
Field of research	*Please consult the scientist you worked with to obtain the relevant four digit ANZRC code*
ORC ID/Scopus Author ID	*Please consult the scientist you worked with to obtain these codes*

Repeat as required

Section 2f – Other collaborators

Details of any other collaborators in the project

Other collaborator details	
Name	*Sangeeta Karmokar*
Title	*Dr*
Area of expertise	*Design and Business*
Employer/affiliation	*AUT*
Other collaborator details	

Name	*Javier Estevez*
Title	
Area of expertise	*Motion Capture*
Employer/affiliation	*AUT*
Other collaborator details	
Name	*Hollee Fisher*
Title	
Area of expertise	*E-Textiles*
Employer/affiliation	*AUT*

Repeat as required

Section 4 – Assessment of success

Please tell us more about what you think worked well and what did not with this project.

Assessment of success	
Was the target audience reached, and how was that achieved?	*Yes, the audience was targeted initially through a web page, event flyers, and through AUT South marketing. However the most effective recruitment was done through personal visits by a member of the team Dr Sangeeta Karmokar, to individual schools, connecting with science, mathematics and textiles teachers and careers advisors in South Auckland. These teachers organised for groups of students to travel to and from the workshops via bus, in a number of cases.*
If the target audience was **not** reached, what were the barriers?	*While some individuals attended particular sessions, transported by parents, the most effective recruitment was when schools provided buses for groups of young people to travel to and from the workshops. Some schools weren't able to provide this service. If we were to continue to develop workshops in this area, it would be good to budget for additional transport support. A session run during the School holidays and one on a long weekend had slightly lower numbers of attendees. As these two sessions were also towards the end of the semester, the timing of sessions appears to be critical.*
Please describe the level of engagement from the science sector (where applicable)	*Leading researchers and academics from across AUT, supported by research technicians and students, contributed the various sessions. The commitment and enthusiasm of staff and the support and engagement of AUT student assistants, were critical to the success of the workshops. This enabled challenging but accessible introductions by world leading experts such as Astronomy Professor Sergei Gulyaev, as well as intensive workshop and activity support, with a good ratio of assistants to participants. The hands on sessions were very successful, with high energy levels and enthusiasm evident over the five hours of each workshop.*
Elements of the Project design that worked well and lessons learnt	*The format and length of sessions worked well – we began each session at 11.00 am with a one to one and a half hour introduction. After breaking for lunch for 40 minutes, the afternoon was spent engaged in workshop, experimental or problem solving activities, with a 20 minute afternoon tea break at 2.30 pm.*

	The location at AUT's South Campus was excellent. Catering was important to keeping students on site and energised with students able to play outside in the park like grounds during the break. *On average we lost 5 students across the day, per session, however most students stayed for the full 5 hours, which was quite remarkable for a voluntary, weekend event.* *The enthusiasm of the presenters of the workshops was contagious – the students were very engaged in all activities. All AUT staff involved said they would be very happy to contribute again in the future, and a number have suggested ways the sessions could be developed further.* *The involvement of Maori and Pacific Islands student assistants was very successful and should be encouraged in any firther projects.* *Giving prizes to the most active participants in some sessions like maths and stats; radical engineering; physics and astronomy; gaming and artificial intelligence (Westfield gift vouchers of $100, $70 and $30 at each workshop) was well received.* *In other sessions, like wearable technologies, all the students were 'rewarded' by being given electronic components, 'how-to' booklets and lists of suppliers and online maker sites, so as to be able to continue with other projects if they were interested .A number of the young women in the wearable technologies session said they had no understanding of how electronics worked prior to the workshop, but found their knowledge and interest increased through making and understanding how the textile based electronic components worked. Discussions about how e-textiles could be used in the future led to some very innovative suggestions.* *While it was a big effort, setting up and demonstrating high end 3D technologies like Mocap, VR and 3D scanning and printing was very successful in attracting and engaging young people. For many it was the first time they had seen or used Motion Capture or VR. Backed up by discussions about 3D data and programming, this particular session considered both scientific and creative application areas. While it was not possible to actually print 3D forms generated by students on the day. These are subsequently being printed at AUT's advanced 3D printing Lab and are being given back to participating schools.* *It was difficult to run formal evaluations for each session –we (the three grant applicants) were all very involved in the delivery and smooth running of each session. When students were asked at the end of the day if they had enjoyed the sessions and if they found them informative they always replied yes, loudly and enthusiastically. Feedback about what they liked included: 'Learning about new things'; 'The opportunity to play with cool technology'; 'Winning prizes' ; 'Solving problems' and 'Making stuff'. The only negative comment recorded was: 'The lunch is too healthy;'* *Comments from teachers and parents were also extremely positive. The levels of engagement shown by participants over all the sessions also indicated high levels of satisfaction.*
The extent to which the original aim of the Project (as set out in the Application) were achieved	*The aims of the project were met.* *The target audience was successfully engaged.* *The attendance levels were good, particularly given the relatively short lead in period between funding confirmation and the programme delivery. The program attendance ranged from 30 to 90 participants across the various sessions.* *Limited industry engagement was possible due to the weekend timing of sessions and lack of availability of proposed speakers. This was not a problem*

	given the strong calibre of AUT staff speakers, but the issue could be addressed with a longer lead in time. *The energy level and engagement was very high in all workshops, with all students participating in the activities which ranged from hands on making workshops, to experimental sessions to puzzles and competitions*

Section 5 – Statistical information

The numbers of participants in the projects, broken down by school attended, gender, age range and other demographic factors (e.g. Maori, Pasifika, from low decile school, outside school system, from rural community.

The age group in all workshops was 13-18 y.o. with an average age of 15; with about equal proportion of male and female participants (apart from workshop 1 where most of the students were female); over 90% of participants were Maori and Pasifika; all came from urban South Auckland schools. These included Otahuhu College, Manurewa College and Aorere College. Students from year 9- 13 participated in the workshops. A few parents and family members also attended and participated in some of the workshops but mostly it was students who attended. A few teachers also attended and participated in particular sessions. Three assistants were Maori or Pacific Island students.

Workshop 1: Wearable Technologies - 45

Workshop 2: Numbers don't lie or do they? Mathematics and Statistics – 55

Workshop 3: 3D Technologies – 90

Workshop 4: Beyond our blue earth? Physics and Astronomy - 50

Workshop 5: Radical Engineering: Answering the unanswerable – 30 (school holiday)

Workshop 6: What's in the cloud? Gaming & Artificial Intelligence – 40 (long weekend)