Unlocking Curious Minds Final Report

Section 1

Project Details

Contract ID	*AITX1502*
Project Name	*STEMpreneurial Bugs for South Auckland Youth*
Lead Organisation	*Auckland University of Technology*
Contact person	*Dr. Sangeeta Karmokar*

Section 2a

Description of completed Project

Progress of the Project, including achievement against Project Tasks

Report for period to	*June - December 2016*
Description of target population	*The target group of this project consists of high school/college students from South Auckland between the ages of 13-18 years. Taking into account the demography of South Auckland a high proportion of the target group will be Maori and Pacific youth. Students from schools in low socio-economic areas will be invited to become involved in the project. Many in the target group are vulnerable to circumstances, contexts and the availability of resources to facilitate effective education.*
Key project highlights	*• Six workshops delivered between 6 August and 22 October* *• High level of engagement of participating students from South Auckland schools, with participant numbers ranging from a minimum of 40 to a maximum of 80 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 and STEM-TEC websites, for example:* *https://stemtec.aut.ac.nz/news-and-events/may-2016/11-may-2016-receiving-a-$25,000-grant-from-the-mbie-for-the-project-stempreneurial-bugs-for-south-auckland-youth* *• Documentation of workshops including video and photographic documentation (examples below):* *https://stemtec.aut.ac.nz/news-and-events/september-2016/10-september-2016-workshop-numbers-dont-lie-or-do-they-maths-and-stats-for-school-students-from-south-auckland* *https://stemtec.aut.ac.nz/news-and-events/september-2016/24-september-2016-*

Section 2b

High level list of activities

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

Date	
6-Aug-16	*Smart Clothes: Smart Textiles and Wearable Tech: A presentation about international projects, leading NZ wearable technology companies and AUTs Textile and Design Lab. Workshop on building fabric sensors by Dr. Donna Cleveland supported by 2 undergrad students who are also working in smart textiles research. 60% of the audience were girls. A very hands on workshop that introduced basic principles of electronics through making textile circuits.*

20-Aug-16	*Print the Future: 3D Technologies and Virtual Reality: A presentation on the concepts and uses of 3D technologies including 3D Modelling, Printing and Virtual reality This was followed by 3 workshops delivered by staff and PG students from Colab and Art and Design including: 3D printing and scanning technology demo's (Ross and Lisa Dreyer): Motion capture demo and engagement session including use of Mocap and VR technologies in creating movie - The Green Fairy (Alejandro Davila). 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).*
10-Sep-16	*Numbers Don't Lie or Do They? Maths and Stats. 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 traffic control, climate change, pollution and ecology. A panel of speakers included Dr Sarah Marshall, Dr Robin Hankin, Associate Professor Sergiy Klymchuk, Dr Jesse Pirini and Nick Patterson. Inspiring entreprenerial talks were given by Dr Jesse Pirini who discussed the concept of entreprenership using many examples and shared his own experience in establishing and running a maths tutoring company and Nick Patterson who shared entreprenerial/commercial activities of his students from Rongomai School. Link to photos and video: https://stemtec.aut.ac.nz/news-and-events/september-2016/10-september-2016-workshop-numbers-dont-lie-or-do-they-maths-and-stats-for-school-students-from-south-auckland*
24-Sep-16	*On and Beyond Our Blue Earth? Science (Chemistry, Biology, Physics & Astronomy).There were very interesting and visual presentations on ecology, biology and chemistry by Dr John Perrott and Wendy Emson, on physics and astronomy by Tim Natusch and Dr Willem van Straten. There were also several engaging hands-on activities including making different sorts of yummy ice-cream, modelling biological evolution using soft toys, producing jellies via chemical reactions, modelling distances in the Solar System on the desks and floor, and other activities run with support from six AUT postgraduate student assistants. Link to photos and videos: https://stemtec.aut.ac.nz/news-and-events/september-2016/24-september-2016-workshop-on-and-beyond-our-blue-earth-science-chemistry,-biology,-physics-And-astronomy-for-school-students-from-south-auckland*
15-Oct-16	*Radical Engineering: Building stuff & then pulling it apart.There were very engaging hands-on activities on flying paper airplanes and building wave machines using jelly babies run by Associate Professor David Wilson. The students were inspired by Paul Elliott's talk on his journey in engineering and entrepreneurial presentations by Dr Jonathan Currie and Alan Brannigan who shared their experiences in establishing and running their high-tec companies - Inverse Problems and Vigil Monitoring respectively. Link to photos and video: https://stemtec.aut.ac.nz/news-and-events/october-2016/15-october-2016-workshop-radical-engineering-building-stuff-And-then-pulling-it-apart-for-school-students-from-south-auckland*
22-Oct-16	*What's in the cloud? Gaming & Artificial Intelligence. There were very interesting and visual presentations on gaming by Dr Roopak Sinha and Steffan Hooper; human-computer interaction by Dr Philip Carter; IT and entrepreneurship by Nick Pattison; and cloudification of IT by Associate Professor Jairo Gutierrez. There were also several engaging hands-on activities on developing games using playing cards and dice and setting up and modifying rules for them. They were run by Steffan Hooper with support from four AUT postgraduate student assistants.Link to photos and videos: https://stemtec.aut.ac.nz/news-and-events/october-2016/22-october-2016-workshop-whats-in-the-cloud-gaming-And-artificial-intelligence-for-school-students-from-south-auckland*
Repeat as required	

Section 2c

Engagement activities with science and/or technology

Science and technology activities completed by the participants

Science activity	
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.*

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.*
Freen Fairy First Virtual Reality Movie in NZ	*A brief introduction on film making and virtual reality was presented by Alejandro - Director of "The Green Fairy", first Virtual reality movie in NZ. Students interacted with the charaters from the movie and experience vitual reality movie in the real world with a mounted head display (HMD).*
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.*
Building wave machines using jelly babies	*Associate Professor David Wilson with support of an AUT postgraduate student conducted an activity of building wave machines using jelly babies by the participants. Many important concepts from physics and engineering were demonstrated and discussed in the process.*
Design a flying paper airplane	*Discussing and designing a paper airplane so it has the smoothest and longest flight (with materials provided only) facilitated by Associate Professor David Wilson. It well might be a step towards the Paper Airplane World Championship for some participants https://www.youtube.com/watch?v=SUyqakRMrxo*
Simulation of the Monty Hall paradox	*The famous Monty Hall statistics paradox was simulated using carton boxes instead of doors, and prizes of onions and chocolates instead of goats and Ferrari. A computer simulation was demonstrated followed by good discussions facilitated by Dr Sarah Marshall.*
Modelling distances in the Solar System	*Dr Willem van Straten and Tim Natush with support of two AUT postgraduate students conducted an activity of modelling distances in the Solar System on the desks and floor.*
Puzzles Contest	*A contest in solving very engaging and provocative puzzles with unexpected solutions and surprised answers in the contexts of science, shape and money conducted by Associate Professor Sergiy Klymchuk.*
Making and tasting different sorts of ice-cream	*Wendy Emson with support of four AUT postgraduate students conducted the activity of making different sorts of ice-cream by the participants. Some important concepts from chemistry were demonstrated and discussed in the process.*
Modelling biological evolution using soft toys	*Wendy Emson with support of four AUT postgraduate students conducted the activity of modelling biological evolution using soft toys by the participants. Some important concepts from evolution were demonstrated and discussed in the process.*
Producing jellies via chemical reactions	*Wendy Emson with support of four AUT postgraduate students conducted the activity of producing jellies via chemical reactions by the participants. Some important concepts from chemistry were demonstrated and discussed in the process.*
Game development using playing cards and dice	*Steffan Hooper with support of four AUT postgraduate students conducted an activity of developing games using playing cards and dice and setting up and modifying rules for them.Many important concepts from game development were demonstrated and discussed in the process.*
Creating a high-tec company in groups	*Dr Jesse Pirini facilitated a group activity on brainstorming and creating high-tech companies by the participants. Different interpretations of the concept of entrepreneurship were discussed on the way.*

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	*Dr. Donna Cleveland 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.*
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*
Virtual Reality Movie	*A stage was set up with all the charaters, screen, Head Mounted Display unit (HMD) for students to experience the movie in virtual world. Posters of all charaters were provided to students so that they can create a mask and act live their favourite charater from the movie.*
Mixers, milk and other ingredients for ice-cream	*Wendy Emson with support of four AUT postgraduate students conducted the activity of making different sorts of ice-cream by the participants using mixers, milk and other ingredients.*
Glass containers and ingredients for jellies	*Wendy Emson with support of four AUT postgraduate students conducted the activity of producing jellies via chemical reactions by the participants using a number of ingredients of different structure and colour in glass containers.*
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.*
Paper, pens, cards, dice, soft toys, spoons, boxes	*These were used for a number of activities including modelling distances in the Solar System on the desks and floor; modelling biological evolution; game development; simulation of Monty Hall statistics paradox.*

Section 2e

Science and/or technology expertise

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

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*
ORC ID/Scopus Author ID	*Please consult the scientist you worked with to obtain these codes*

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*
ORC ID/Scopus Author ID	*Please consult the scientist you worked with to obtain these codes*
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*
Name	*Associate Professor Jairo Gutierrez*
Title	*Associate Professor*
Area of expertise	*Computer Science*
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*
Name	*Sangeeta Karmokar*
Title	*Dr.*
Area of expertise	*Creative Technologies, entrepreneurship*
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*
Name	*Donna Cleveland*
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*
Name	*Sarah Marshall*
Title	*Dr*
Area of expertise	*Statistics, analytics*
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*
Name	*Robin Hankin*
Title	*Dr*
Area of expertise	*Statistics, 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*
Name	*Jesse Pirini*
Title	*Dr*
Area of expertise	*Communication, entrepreneurship*
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*
Name	*Jonathan Currie*
Title	*Dr*
Area of expertise	*Engineering, entrepreneurship*
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*
Name	*John Perrott*
Title	*Dr*
Area of expertise	*Applied ecology, biology, environment*
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*
Name	*Wendy Emson*
Title	
Area of expertise	*Chemistry, biology*
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*

Name	*Willem van Straten*
Title	*Dr*
Area of expertise	*Astronomy, astrophysics*
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*
Name	*Tim Natush*
Title	
Area of expertise	*Astronomy, astrophysics*
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*
Name	*Phil Carter*
Title	*Dr*
Area of expertise	*Computer Science*
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*
Name	*Roopak Sinha*
Title	*Dr*
Area of expertise	*Computer Science*
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*

Other collaborator details	
Name	Nick Patterson
Title	Mr.
Area of expertise	STEM education, entrepreneurship
Employer/affiliation	Director of STEM Rongomai Centre, Rongomai School
Name	Alan Brannigan
Title	Mr.
Area of expertise	Entrepreneurship
Employer/affiliation	CEO of Vigil Monitoring
Name	
Title	
Area of expertise	
Employer/affiliation	

Section 3

Section 4

Assessment of success

Please tell us more about what you think worked well and what didn't.

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.*

Please describe the level of engagement from the science and/or technology 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. The hands on sessions were very successful, with high energy levels and enthusiasm evident over the five hours of each workshop. Many entrepreneurs were also invited in these workshop to inspire students and show a future pathways in STEM areas.*
Elements of the project design that worked well and lessons learnt	*The format and length of sessions worked well – we began each session at 11.30 am with an introduction and inspiring presentation(s). 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.* *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.* *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 some suggested ways the sessions could be developed further.* *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 .* *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 VR movie. 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.*
The extent to which the original aims and deliverables 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 possibly 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.*
Do you consider the project was successful and how did you measure this?	*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 forms were given at four out of six workshops and 100% respondents answered "yes" to the question about whether they would recommend the workshops to their friends. Most common responses 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.* *One more measure of the project as a dollar return is based on the findings from the 2016 impact evaluation report prepared for Ako Aotearoa National Centre for Tertiary Teaching Excellence by the Buisness and Economic Research Limited (BERL). Some statistics from the report was presented by Rhonda Thomson, Ako Aotearoa National Project Funds Manager at the Northern and Central Hubs Colloquium on 7 November 2016. Based on the report, if only 10 out of the total number of participants who attended our workshops would choose and complete a STEM related tertiary qualification when otherwise they might not have then GDP increases by $100,000 per annum. This is a 400% RoI in our project per annum for the MBIE.*

What are your plans and any opportunities you have identified beyond this project for continuing engagement with this target group.	*All participants were encouraged to contact us regarding any ideas, enquiries and suggestions regarding STEM projects and events. Their STEM teachers and school career advisors have our contact details. We already have a number of partnerships and joint projects with students from South Auckland schools. An example is STEM Centre at Rongomai School led by Nick Patterson whose students are involved in two joint projects with AUT units - Colab and Radiofrequency Identification Applications Laboratory. We also disseminated our project internationally through an article to be published in the International Journal of Engineering Pedagogy (with the acknowledgment to the MBIE).*

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

Statistical data	
Number of participants (female)	*180*
Number of participants (male)	*90*
Number of participants (other)	*Number*
Total (some students attended more than one workshop)	*270*

Age profile of participants	
0-4	*Number*
5-9	*Number*
10-14	*200*
15-19	*70*
20-24	*Number*
25+	*Number*
Total	*270*

Ethnicity	
New Zealand European	*10*
New Zealand Maori	*170*
Samoan	*16*
Cook Island Maori	*0*
Tongan	*15*
Niuean	*0*
Chinese	*0*
Indian	*17*
Other (Islamic)	*42*
Total	*270*

Place	
City	*Most participants were from South Auckland*
Town	*Number*
Rural	*Number*
Total	*Number*

Region	
List - Repeat as required	*Number*
Total	*Number*

School	
	Number
Otahuhu College	*80*
Zayeed College for Girls	*38*
Rongomai School	*40*
Pakuranga College	*10*
McAuley High School	*20*
Lynfield College	*5*
Tangaroa College	*36*
Western Springs College	*6*
Blockhouse Bay Intermediate	*4*
Avondale College	*8*
Manurewa College	*23*
Outside school system	
Total	*270*