

An indigenous approach to engineering effective learning opportunities

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Abstract: *Support services for indigenous students in engineering studies range vastly between institutions. These support services have been established as a remedial process aimed at increasing retention and completion rates and are often seen in a negative light, only providing support to those who are failing. How do we facilitate effective learning opportunities to better support indigenous students? How can this model guarantee significant progress towards achieving equity objectives, while incorporating innovation, sustainability and transferability?*

An alternative and possibly more successful approach has been adopted at the Faculty of Engineering at the University of Auckland. The Māori Participation Strategy is based on 5 'R's; Readiness, Recruitment, Retention, Research, and Role Modelling. These facets of the strategy have been integrated to shift perceptions of the approach amongst students and academics within the university. The strategy has been recognised with several awards and is generally referred to as a model of best practice.

Examples of the five facets are provided in this paper demonstrating the innovation opportunities possible and the potential for strategies of this type to significantly improve the outcomes for all students. Several of the initiatives developed have been duplicated within mainstream practice demonstrating the broader applicability of such initiatives.

Introduction

The School of Engineering at The University of Auckland has designed an effective participation strategy based on recruitment, retention, role modeling, research and readiness programmes for its Māori and Pasifika students. These programmes are justified by the university's Treaty of Waitangi obligations, equity considerations, and also by the view that our Māori and Pasifika students make very good engineers in practice. In this paper we will explore the relationships between these programmes and highlight its effectiveness, innovation, sustainability and transferability.

Effective Learning Opportunities

International initiatives

Inequalities and minority issues within engineering and science based courses are an international trend. The National Academy Press (1997) stated that many minority-group students are deterred from careers in science and engineering by inadequate preparation, a scarcity of role models, low expectations on the part of others, and unfamiliarity with the culture and idioms of science. The United States of America has acknowledged that while engineering design has been considered a noble profession, it has been saturated by white males, not a representative cross-section of their population

in terms of females and minorities. The elementary and secondary curricula of their nation needs to be targeted and enhanced in engineering to attract these underrepresented groups in engineering. (Crawford et al. 1994). Following a review of engineering outreach programmes and resources throughout American Universities, several common themes were identified which included: active learning through hands-on activities, inquiry-based learning, curriculum supplements, engaged role models, younger student focus, and K – 12 teacher involvement. (Jeffers et al. 2004). The University of Maryland Baltimore County has been recognized as a leader in the national effort to attract domestic students generally, and underrepresented minorities and women specifically, into doctoral programs in the STEM fields by creating a welcoming and positive environment for underrepresented students, an environment that will attract and support doctoral students throughout their academic careers and position them to be successful in the job market. (Bass et al. 2007).

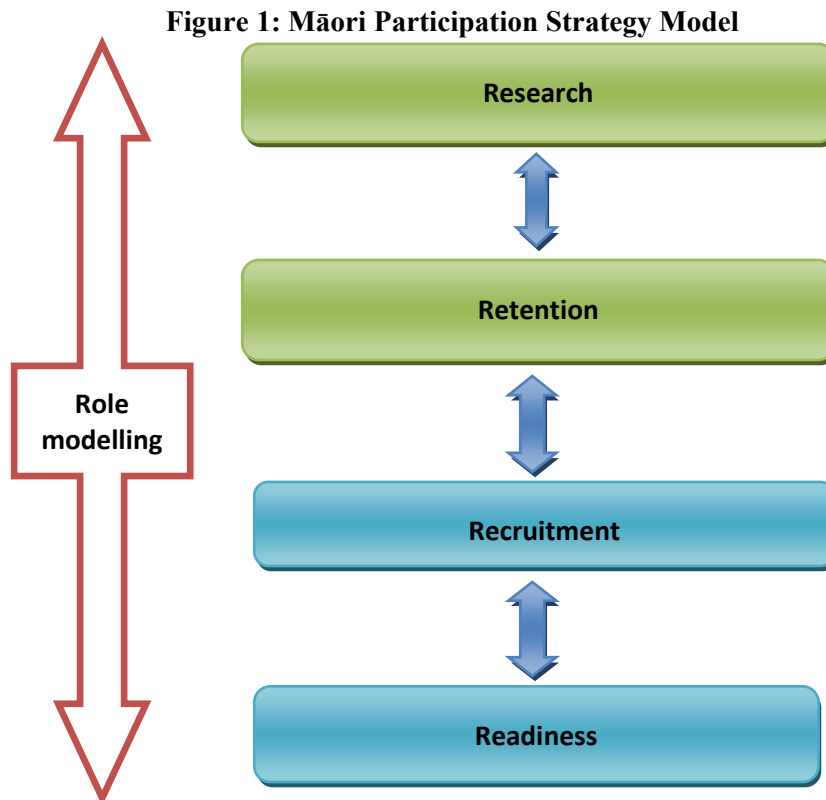
Learning opportunities in New Zealand Institutions

Compulsory education in New Zealand has the second highest rate of educational inequality in the OECD. None of the main under-represented groups within the University- Māori, Pacific and staff and students with disabilities- has achieved demographic parity with the wider population. Students from these under-represented groups have not achieved adequate representation in degree completions and postgraduate programmes. (*The University of Auckland, 2005*)

New Zealand has entered a period of demographic change which has significant implications for the tertiary sector. All New Zealand universities have recruitment road shows which travel the length and breadth of the country visiting schools, including areas with higher concentrations of Māori and Pacific people. Among the different regions in New Zealand, Auckland is projected to experience the largest Māori population growth (up 37,000, from 144,000 in 2001 to 181,000 in 2016). Auckland Region will continue to house one-quarter of New Zealand's Māori population over the projection period. (*Māori Population, 2005*) In preparation for the demographic change, some universities such as Otago, Waikato and Massey have established offices in Auckland to enable more personal contact with potential students from this region. (*University of Auckland Māori and Pacific Recruitment Strategy, personal communication, 12 July 2009*)

Engineering Effective Learning Opportunities

The Māori and Pacific Recruitment Strategy aims to match the proportion of Māori and Pacific (MPI) school leavers admitted to the University with the proportions of such students in the Auckland and Northland region gaining University Entrance. (*University of Auckland Māori and Pacific Recruitment Strategy, personal communication, 12 July 2009*) Within the Auckland catchment area, 6.2% of Māori and 6.6% of Pasifika school leavers qualified to attend University. The number of students enrolled in the Faculty of Engineering is alarmingly low in comparison. In 2008, 2.1% of students enrolled in the engineering school identify as New Zealand Māori, 2.5% identify as Pasifika. (*Equal Opportunities, 2008*) With this in mind, effective learning opportunities for indigenous peoples are vital to the recruitment of new students, retention of current students and research outputs of postgraduate students. To facilitate effective learning opportunities to better support indigenous engineering students, the Faculty of Engineering have created the Māori Participation Strategy model. This bottom up approach is essential if the Faculty of Engineering is to match Auckland's demographic targets.



Four key facets and one impacting tool make up the entirety of the Māori Participation Strategy model: *Readiness*- preparing secondary school students for entry into Engineering; *Recruitment*- presenting a more accessible image of university education with role models promoting the relevance of engineering studies in provinces and schools; *Retention*- the retention of MPI's within the engineering degree; and *Research*- growing and supporting MPI researchers in the engineering field with its inherent contribution to role modelling. Commonly known as the 4 R's, each component cannot be achieved without the inclusion of the role modeling tool. *Role modelling*- the use of academic and leadership achievements of current students and staff as role models within the degree and the wider university- is a tool that supersedes all facets.

Impacting on all facets is Role modelling, acting as a support catalyst for all R's, but at the same time is strongly reliant on all R's for its existence and growth. Role modelling impacts on both Recruitment and Retention, offering visual representation and accessibility to engineering careers within studies and as a professional engineer in the industry. Innovative projects and support programmes are based on the connectedness and relationships between each area. It is through each of these programmes that effective learning opportunities are created. This paper will focus on aspects of this model in 3 parts and provide case studies to highlight projects and programmes.

Part 1: The core: Role modeling, Recruitment and Retention

Part 2: New inspiration: Role modeling and Readiness

Part 3: Distant horizon: Role modeling and Research

Part 1: The core: Role modelling, Recruitment and Retention

The equity objectives within the school of engineering are drawn from the University of Auckland's responsibilities and obligations under Te Tiriti o Waitangi (Treaty of Waitangi). The University

Strategic Plan 2008-2012 (2008-2012, 2007) states the following actions, responsibilities and objectives for the School of Engineering:

- Implement plans to increase MPI student numbers by launching the Ngā Hoa O Te Kupenga Rorohiko (Distance Mentoring Project), facilitating multi-year mentoring relationships between SPIES students and secondary school students in Year 11. [10]
- Develop and implement with the Manukau Institute of Technology a foundation course for students who do not have the necessary secondary school preparation that will allow them to qualify for admission to the Faculty [10]
- Develop and implement strategies to address the low number of Māori and Pasifika academic staff [10, 13]
- Develop international linkages in teaching and research with other indigenous groups involved in engineering education [1, 3, 10]

An innovative way to achieve equity objectives is through the recruitment, retention and role modelling programs delivered through SPIES (South Pacific Indigenous Engineering Students).

Case study 1: SPIES

SPIES was formed in 1993 as a central support group for Māori and Pasifika Engineering students. As Mitchell (2006) points out, SPIES was formed to make the School of Engineering a more inviting place as tertiary institutions currently are Pākehā (non-indigenous) institutions which are based on a Pākehā framework of ideas and systems. SPIES student's role model, mentor and tutor first year students, thus building the SPIES cohort and increasing retention and completion rates.

It is a tradition for the SPIES group to take their message to the people face to face (*kanohi ki te kanohi*). At present the SPIES group travel to the regions both nationally and internationally to visit schools and promote tertiary education. Using themselves as role models and presenting a more accessible image of university education, SPIES hopes to increase Māori and Pasifika participation in post-secondary education, especially engineering. (Morgan, 2008)

In addition to the student led recruitment drives, secondary school students are invited on campus to take part in Indigenous Engineering Day, an engineering open day specifically designed to cater for MPI's. Prospective students are able to attain a hands on experience of university life, engineering studies and attend engineering site visits.

Further to their attendance on-campus, potential students are encouraged to apply for the Māori and Pasifika Targeted Entry Scheme (MAPTES). All successful applicants are fast tracked into the Tuākana Engineering Programme, a mentoring and tutoring programme available to MPI engineering students. From this time on, each cohort is monitored and the academic performance of additional learning opportunities are provided including targeted tutorials and study retreats (*wānanga*).

The success of these outreach activities by SPIES has been evident in the steadily increasing number of Māori and Pasifika students enrolling in the Bachelor of Engineering degree. The cohort of Māori and Pasifika at the Faculty of Engineering continues to grow in number and strength from year to year. The visibility of Māori and Pasifika students in the Faculty of Engineering is due to both the growing number of students, strong Faculty support and the interest generated by SPIES activities. (Morgan, 2008)

Part 2: New inspiration: Role modeling and Readiness

In 2006, the Māori Participation Strategy focused specifically on 3 R's- Recruitment, Retention and Role modelling. (Morgan, 2005) The growth and sustainability of the 3 R's allowed for the addition of another facet to the strategy. In 2008, the concept of Readiness was added to effectively prepare secondary students for the BE (Hons) degree and SPIES for the engineering industry.

Case study 2: Ngā Hoa o te Kupenga Rorohiko Distance Mentoring Project

The Ngā Hoa o Te Kupenga Rorohiko is an extension of the current tuākana tutoring and mentoring programme at the Faculty of Engineering. The readiness support programme facilitates regular on-line mentoring between SPIES and secondary school students. Contact for mentoring is made possible on a regular basis with the improved availability of on-line and mobile communications technology. (Morgan, 2006). The establishment of the distance mentoring programme is modeled on on-line mentoring programmes used to enhance tertiary teaching. Although the use of digital technologies to facilitate mentoring is not new, the initiative to provide a seamless cascade of mentoring from professional engineer to undergraduate engineering student to secondary school student is new. Further the cascade of relationships is created on the basis of a four year cycle which regenerates. That is, as the secondary student completes preparation for tertiary study, the SPIES student completes their undergraduate degree and moves into employment, allowing a new cascade to be created with more indigenous professional engineers, more SPIES student mentors, and therefore the resource to mentor more secondary school students. (Morgan, 2006)

In September 2009, the Ngā Hoa o Te Kupenga Project was launched in Auckland. A total of 16 Māori and Pasifika secondary students from across New Zealand were selected to participate in this new 3 year distance mentoring project. Mentors are current members of SPIES and are currently mentoring or tutoring Part 1 engineering students. A relationship between the secondary students and their mentor was initiated in person at the project launch. Each mentee and mentor received a PDA and the mentoring relationship commenced in October 2009. The mentoring relationship is conducted via video calling mentoring sessions and teleconference tutorial sessions in small groups.

The Nga hoa project helps students to identify interests and skills and match them to an engineering based career. The mentors provide advice on subject selection, develop networks with key people in tertiary and help develop general skills such as communication and teamwork.

Increasing the number of Māori students entering engineering study will benefit everyone involved as addressing the specific paucity of Māori participation in engineering now will avoid a greater crisis in the future. The intention with Ngā Hoa o Te Kupenga Rorohiko is to extend the concept into the secondary schools and also into the professional arena via the mentoring relationships established.

Part 3: Distant horizon: Role modelling and Research

The creation of the Māori External Liaison, Māori Student Mentor and the Pasifika Student Mentor positions has enabled the Faculty to be more proactive towards Māori and Pasifika. The Māori External Liaisons primary role is to recruit more Māori and Pasifika students into the Faculty. The Māori Students Mentor academically supports Māori students while the Pasifika Student Mentor academically supports Pacific students and manages the Tuākana tutoring programme. All three positions are line managed by the Associate Dean Māori and are known as the Tuākana Engineering Team. Each member of the team manages and facilitates a component of the Māori Participation Strategy. The Māori External Liaison directs the Recruitment, Role modelling and Readiness portfolios; the Māori and Pasifika Student Mentors oversee the Retention programmes; and the Associate Dean Māori manages the Research aspect of the strategy.

Case study 3: Whakatau Kairangi Postgraduate Project and NETS

The purpose of the Whakatau Kairangi project is to unify the Māori and Pasifika post graduate student cohort in engineering, with the aim of providing support a (confidence to participate) for attendance at writing retreats, raise awareness of relevant conferences such as NETS 2010 (*Native Engineering and Technology Summit*) and encourage continued involvement in the SPIES network. By achieving these objectives a strengthened cohort is built that empowers the post graduate students to continue or renew involvement in SPIES, SPPEEx (South Pacific Professional Engineering Excellence) and other indigenous activities that are relevant to their career and personal development. This project is achieved through the facilitation of a series of evening gatherings and the incorporation of a short presentation on up coming opportunities. Guest speakers are invited and talk on topics that include

career positioning and Kaupapa Māori research methodology as it applies to engineering. At the end of the series a SPIES Kairangi writing retreat is available for post graduate students to attend with an engineering focus.

NETS will hold its inaugural international conference in 2010 (*Native Engineering and Technology Summit*, 2009). The University of Hawai'i at Hilo and The University of Hawai'i at Mānoa will host the summit and focus on themes such as appropriate engineering/ technologies for Pasifika peoples and Native peoples' participation in engineering education, practice and profession within the Pacific. The need to create this forum evolved due to the paucity of native perspectives and practices taught in the Engineering and Technology degrees.

Participants in the Whakatau Kairangi Project will be encouraged to attend present their research at the NETS Conference and to share their knowledge with like minded engineers of the Pacific nations.

Summary

In summary, the five parts of the Māori Participation Strategy align with the objectives of the University Strategy, and are central to achieving equity goals within the Faculty of Engineering. Student led recruitment activities have the ability to potentially recruit new students to the University while at the same time it allows current MPI engineering students to give back to their own communities. Innovation excels in the attempt of new creative approaches to advancing equity through facilitating a multi-year mentoring relationship between SPIES students and secondary school students and also by taking recruitment drives international. Intended continuation and long term effects of the strategy are evident in the growth and sustainability of the SPIES group, and the creation of SPPEEx. The transferability of this model is potentially straight forward provided the seed for any initiative of this type, which addresses equity issues, is planted in good soil. The good soil would be adequate resources and a cohort of motivated and confident indigenous students, supported by an indigenous member of the Faculty.

Programmes within the Māori Participation Strategy have received awards including an AaeE award for Excellence in Inclusivity and the award for The University of Auckland Excellence in Equal Opportunities Award in 2003 and 2008.

References

2008 – 2012 Strategic Plan- Faculty of Engineering, The University of Auckland. (2007) Accessed at <http://www.engineering.auckland.ac.nz/uo/fms/default/engineering/staff/docs/Strategic%20Plan.pdf> on 25 Aug 2009.

Bass, S. A., Rutledge, J. C., Douglass, E. B., Carter, W. Y. (2007). "The University as Mentor: Lessons Learned from UMBC Inclusiveness Initiatives." *The CGS Occasional Paper Series on Inclusiveness, Volume 1.*

Crawford, R. H., Wood, K. L., Fowler, M. L., and Norrell, J. L. (1994). "An Engineering Design Curriculum for the Elementary Grades." *Journal of Engineering Education*, 83(2), 172-181

Equal Opportunities Office Activities and Statistics Report 2008. (2008) Accessed at <http://www.auckland.ac.nz/uo/home/about/eo-equity-office/eo-reports-and-plans> on 5 Oct 2009

Jeffers, A. T., Safferman, A. G., Safferman, S. I. (2004). "Understanding K-12 Engineering Outreach Programs." *Journal of Professional Issues in Engineering Education and Practice*, 130(2), 95-108

Māori Population: Looking out to 2021. SNZ Hui Tamata. (2005) Accessed at www.huitaumata.maori.nz/pdf/population.pdf on Aug 5, 2009

Mitchell, S. (2006) SPIES: *An Evaluation of Tutoring Programs for Māori and Pasifika Students at the Faculty of Engineering, University of Auckland*. Australasian Association for Engineering Education Annual Conference 10-13th December 2006 Auckland University of Technology.

Morgan, T. K. K. B. (2005) *An argument for increased Māori participation in engineering based on potential impacts for education in sustainable development*. IN SPPEEx (Ed.) 2005 Symposium: Indigenous Technologies and Sustainable Development. Auckland, 29-30 September, 2005.

Morgan, T. K. K. B. (2006) *Ngā hoa o te kupenga rorohiko – an innovative distance learning programme to address the paucity of Māori student enrolments in engineering*. AaeE Annual conference, Auckland, 10-13 December, 2006.

Morgan, T.K.K.B., Murray, M.R. *Transforming Institutional Perspective by Rediscovering Māori and Pacific Ingenuity*. (2008), Te Toi Tauira mo te Matariki Conference 2008, Waipuna Lodge, Auckland, 7 - 10 October, 2008

Native Engineering and Technology Summit. (2009) Accessed at <http://uhhconferencecenter.com/native-engineering-and-technology-summit-nets-july-11-17-2010.html> on 6 Oct, 2009.

National Academy of Sciences (1997). *Adviser, Teacher, Role Model, Friend: On Being a Mentor to Students in Science and Engineering*. National Academies Press, Washington, D.C

SPPEEx South Pacific Professional Engineering Excellence. (2009). Accessed at www.sppeex.org on 21 Sept, 2009.

The University of Auckland Strategic Plan 2005 – 2012. (2005) Accessed at <http://www.auckland.ac.nz/uoa/home/about/the-university/official-publications/strategic-plan-2005-2012> on 5 Oct 2009

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