



Pre-entry qualifications as predictors of success in first year osteopathic education



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ARTICLE INFO

Article history:

Received 27 July 2017

Received in revised form

5 October 2017

Accepted 6 October 2017

Keywords:

Admission criteria

Osteopathic education

Predictors of success

Tertiary study

ABSTRACT

Admission criteria for osteopathic programmes often include sciences, but research into the value of pre-entry science as a predictor of success in osteopathic education is limited. Furthermore, the literature suggests that the relationship between pre-admission science qualifications and success in studying other healthcare disciplines is unclear.

This mixed methods study explored the relationship between pre-admission academic qualifications and subsequent performance in an osteopathic education programme in New Zealand.

Previous study of Biology conferred a moderate advantage in terms of success in the first semester, but there was no significant correlation at the end of the first year. Other sciences did not appear to confer a benefit on performance in the programme. Participants' experiences supported this finding. Confidence in at least one aspect of their studies was identified by participants as being important: this confidence could stem from prior science studies, transferable skills from other studies, or more abstract factors such as interpersonal skills.

The authors present a model, hypothesising that personal qualities can act as mediators of success within the programme. Caution should be applied in relying too heavily on preadmission sciences and consideration of other factors may help to broaden participation in osteopathic education.

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Introduction

Identifying factors that predict success is becoming increasingly important within tertiary education, as departments come under pressure regarding student success and retention [4]. Osteopathy is a primary healthcare discipline, and educators in this field therefore have responsibilities to the osteopathic profession and to future patients, as well as to the institution and the students themselves, to ensure that the most appropriate applicants are accepted into the programme. A better understanding of the relationship between pre-admission qualifications and experience (for example life experience, informal learning and so on) could be beneficial to an admissions team by helping to establish appropriate entry requirements that ensure a high likelihood of success, while at the same time not being too restrictive and so deterring potential applicants and limiting diversity. It could also be beneficial in identifying current students who might need additional support.

Background

A search of institutional websites indicates that admission criteria for osteopathic education programmes around the world vary with regard to the requirements for Biology and Chemistry: for example, in Australasia there is a greater emphasis placed on Chemistry, whereas in the United Kingdom, Biology is generally considered more important. Furthermore, mature entry students are sometimes not required to meet the same entry requirements, presumably because other factors are considered to compensate for not having studied these subjects.

In New Zealand, the official secondary school qualification is the National Certificate of Educational Achievement (NCEA). The qualification is recognised internationally and NCEA Level 3 is broadly equivalent to the Australian Senior Secondary Certificates of Education and the British General Certificate of Education (GCE) A-Level [11]. Standard admission requirements for school leavers entering the undergraduate osteopathic programme involved in the current study are 60 credits at NCEA Level 3 including a minimum of 18 credits at NCEA Level 3 in Chemistry. There is no requirement for Biology.

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Predictors of success in osteopathic education

Studies into pre-admission qualifications as predictors of success in osteopathic education appear to be mainly restricted to the USA [1], found a relatively strong correlation between pre-admission Grade Point Average and performance in the first two years of an American osteopathy programme, although the correlation between pre-admission qualifications and performance in later parts of the programme appears to be weaker [1,10]. However, these studies looked at graduate entry programmes and the extent to which the findings can be extrapolated to undergraduate entry osteopathic education, which is more common in Australasia and the United Kingdom, is unclear.

Predictors of success in other health-related disciplines

Investigations into the validity of pre-admission grades as a predictor of performance in other health disciplines have produced varying results. Some studies report a strong correlation between high school academic achievements and subsequent success in medical school [5,6,9]. In contrast, the predictive value of high school performance for success in Nursing appears weaker: in a recent systematic review [13], found that while pre-entry Grade Point Average is widely used, there is insufficient evidence to support it being the sole criterion in selecting nursing students. The case for science subjects is also ambiguous: in a recent study [8], found no significant difference in performance at medical school between students with a background of high school sciences compared with those with no science background. Similarly [16], found that high school Biology and Physics were only weakly correlated with subsequent performance in three health related disciplines (nursing, pharmacy and health sciences).

The purpose of this study was to investigate the relationship between pre-admission qualifications and subsequent academic performance in an undergraduate entry osteopathic programme, and to explore the reasons behind that relationship. In the current study, success was defined as passing all subjects studied in the first semester or first year of the osteopathy programme.

Methods

Study design and participants

A sequential mixed-methods design was used in the study. The first part consisted of a quantitative analysis of preadmission qualifications and performance in the osteopathy programme. This was followed up by qualitative semi-structured interviews to explore the effects of preadmission qualifications on the students' experiences within the programme.

The interviewer was independent of the teaching team but was known to the students in her capacity as a Learning Advisor. Ethical approval for the study was obtained from the institution's Research Ethics Committee.

Quantitative data was drawn from existing student files for all students enrolled in the programme during the last five years. Earlier data was excluded because significant restructuring of the programme meant that earlier results would be difficult to compare. Student records were accessed both through the institution's student management system (PeopleSoft®) and via physical records.

Students currently enrolled in the programme were invited to participate in the second part of the study. Potential participants were approached initially via a brief in-class presentation, with a follow-up email via the institutional learning management system. No selection criteria were applied in terms of gender, age, or

ethnicity, but first year students were excluded from the study because of their limited experience of study in the programme and because final grades were not available. Potential participants received information about the aims of the study and the research process prior to recruitment. Ten participants were recruited from a total pool of approximately 40.

Demographics

A total of 68 student records were analysed for the first part of the study, including student cohorts from 2012 to 2014. There were 21 male and 47 female students, with ages ranged from 18 to 52 (mean age 25, SD = 8.56). A large majority of the students were of European ethnicity (75%; $n = 51$), with only small numbers of Māori (2.9%; $n = 2$), Pacifica (7.4%; $n = 5$), Asian (4.4%; $n = 3$) or "Other" ethnicities (10.3%; $n = 7$). This is broadly representative of the demographics of students within the programme. The most common highest qualification on matriculation was NCEA Level 3 equivalent, accounting for 60.3% ($n = 41$) of the sample.

Measurements

Information was collected relating to students' pre-entry qualifications and subsequent performance in their first year of study. Data regarding pre-entry qualifications included NCEA-equivalent level, subject groups (Physics, Chemistry, Biology, English, English-rich, Mathematics, General Science) and grades achieved. Data regarding performance included grades achieved in individual courses within the first year of the degree, Grade Point Average for the first semester and second semester and overall Grade Point Average for the first year. Data for students who did not complete was included in the analysis.

In the second part of the study, semi-structured interviews were used to explore the extent and ways in which the participants felt their entry qualifications affected their experience and performance in the programme. Participants were encouraged to discuss which previously-studied subjects they found helpful in the early part of their osteopathic studies and in what ways those subjects were helpful. Participants were able to choose the location for the interviews: most were conducted on campus, with one conducted via Skype®. A series of questions were used as prompts during the interviews, to ensure coverage of specific topics and also providing flexibility for participants to identify other influences that they considered to be important for their success in first year study. Interviews lasted between 30 and 45 min.

Data analysis

Data taken from student records were recoded into numerical values, with all qualifications being matched to an NCEA-equivalent level.

Microsoft Excel was used for descriptive analysis and SPSS for statistical analysis of the relationship between variables. Spearman's correlation coefficient was used for statistical analysis as this is an appropriate test for non-parametric data [17], and the independent t -test was used to determine potential differences between groups of data; specifically, mean Grade Point Average for students achieving at or above Level 3 in each subject group versus those achieving below Level 3.

Interviews were audio recorded then transcribed verbatim by a transcriptionist. Data from ten interviews was included, as one interview did not record successfully. Transcripts were analysed using a thematic analysis approach. Two researchers independently coded transcripts, then compared to check their coding and identify themes. A deductive approach was used to identify the themes

Table 1
Themes and sub-themes.

Deductive Code	Developed Theme	Sub-Theme
Subjects studied	Content Knowledge	Science Body Knowledge
Other Study/Work	Skills	Writing Skills Study Skills
Other Areas	Personal Qualities	People Skills Motivation Life Experience Confidence

inherent in the semi-structured interview, and was focused on the latent themes underlying the responses, while still acknowledging the explicit themes themselves [2].

Results

A deductive approach was used to initially code data based on the questions asked in the interview, including subjects studied, other study, and other areas that impact. Further thematic analysis modified these codes, resulting in the three main themes of the findings; knowledge, skills and personal qualities. Iterative analysis of transcripts yielded sub-themes, as shown in Table 1. Sub themes were identified through explicit discussion, but also through the meaning behind responses.

The results are presented here under those three main themes, integrating qualitative and quantitative findings for each theme.

Quantitative data is included alongside each theme and is summarised in Table 2. The quantitative data served to support the themes identified in the qualitative analysis.

Knowledge

The impact of knowledge on success via previously studied subjects was examined through both quantitative and qualitative data. Interview participants spoke about science knowledge and knowledge of the workings of the body.

Previous study or experience

No significant correlation was found between the highest level of any single subject studied and the mean Total GPA achieved over the first two semesters and there was no significant difference in mean Total GPA between those who achieved NCEA Level 3 or greater in Physics, Chemistry, Biology, English, Mathematics or English Rich subjects versus those who did not.

However, the highest level of achievement in any single subject showed a medium correlation with the mean first semester GPA ($r_s = 0.352$, $p < 0.05$), suggesting that approximately 12% of the variation in mean GPA was predictable from the highest level of study achieved (as determined by the coefficient of determination, R^2). Similarly, there was a small-to-medium correlation between the highest level of Biology studied ($r_s = 0.298$, $p < 0.05$) and the mean GPA over the first semester, suggesting that approximately 9% of the variation in mean GPA was predictable from the level of Biology studied. There was no significant correlation found for the other subjects considered.

Science knowledge

Participants were asked which previously studied subjects assisted them in studying osteopathy and in particular the value of sciences. Responses were ambivalent, with some identifying science as not relevant because introductory units of study allowed students to 'catch up' or because school sciences were not perceived as directly relevant. This ambivalence was demonstrated in responses, with some participants noting that science was not relevant, some identifying some areas of usefulness and others making ambivalent statements. However, students could recognise that some familiarity was helpful with understanding content.

I'd say, I did notice that some of the younger kids in the class, the ones who had come straight out of school basically handled things. Well they just knew a few things that I didn't know, ah, because they were fresh out of school and I guess that gave them a little bit of an edge, but because I was quite determined and that so I just kept going at the pace it was going and did alright you know. I didn't let it bother me.

Biological Sciences were identified as most helpful, as they provided an understanding of the workings of the body and a base for building further knowledge.

Bioscience, it helped. Mostly anatomy. Just all the root words and being able to tell what something means just based on the root words. You don't have to memorise all the long words and make connections. It's already there.

High level sciences at school were also seen as preparation to perform at the required academic level and manage workloads.

If you can handle chemistry and you're Year 13 that's a good indicator that you'll be able to handle kind of the step-up osteo stuff. Same with biology and physics, any of those three, if you

Table 2
Correlation between pre-entry criteria and grade-point average.

Pre-entry Criteria	Grade Point Average Semester 1		Grade Point Average Semester 2		Total Grade Point Average (Semester 1 & 2)	
	Spearman's rho	p-value	Spearman's rho	p-value	Spearman's rho	p-value
Age	0.149	0.306	0.231	0.110	0.102	0.446
Years Since Last Formal Study	0.253	0.076	0.264	0.064	0.259	0.047*
Highest Level of Study Achieved	0.352	0.015*	0.204	0.169	0.203	0.134
Highest Level of Study Achieved per subject:						
Physics	0.103	0.475	−0.068	0.637	0.126	0.341
Chemistry	0.120	0.406	−0.130	0.368	0.085	0.521
Biology	0.298	0.035*	0.140	0.333	0.213	0.106
English	−0.151	0.295	−0.133	0.357	−0.115	0.386
English-Rich	0.066	0.650	0.040	0.782	0.089	0.501
Maths	−0.090	0.535	−0.232	0.105	−0.062	0.642
General Science	−0.164	0.255	−0.206	0.152	−0.204	0.122

* Correlation is significant at the 0.05 level (2-tailed).

can show that you're able to perform in them then that's a sign that you would actually be capable of doing the coursework because it's quite difficult.

Body knowledge

Nine participants elaborated on the importance of knowledge of the body and how it works. This was seen as gained through various avenues, such as studying sports science and physical education, a massage career or experience and interest in playing sport. Like biology, this formed a knowledge base to build on. Participants also noticed that an awareness of the body and movement, either others' or one's own, created a level of confidence, particularly in practical components.

And I found there was a few guys ... really into sports; that were really natural with it. And there was a student who did massage, and was so natural; whereas I was a bit awkward, at first, so I had to ... I did night school; I did massage just to get over that kind of nervousness.

Skills

Participants identified a number of other factors that impacted success, in addition to content knowledge, highlighting study skills and interpersonal skills as being of particular importance in helping students achieve success in their early osteopathic studies.

Writing and analytical skills

Although quantitative data analysis suggested no correlation between performance and prior study of English-rich subjects, some participants perceived English and other similar subjects, such as history, as being helpful, for example with deciphering terminology or breaking down and critiquing complex ideas. Seven participants spoke about the importance of writing skills. English-rich subjects were particularly identified as being valuable by those who had not taken sciences.

I think English is the key because we've got some really amazing students in the class

Study skills

All participants spoke about the importance of knowing how to be a successful student and meeting academic expectations. These study skills could be gained from formal education at school or previous tertiary study, but also through work experience. Particular skills identified as being helpful included time management, exam skills and writing skills.

Time management involved managing workloads, being self-disciplined, working steadily and maintaining focus. It also included the use of tools such as timetables and study plans. Exam skills were gained through having sat exams, which helped students to know what was expected. Preparation, knowing how to understand exam questions and write well were also key. Writing skills were gained through English and related subjects, but also in the workforce through report writing. Students who had study skills felt that they were able to use these to their advantage and play to their strengths.

So the stuff I did in assessments in high school, I did bring into it, because why not apply what works for you?

Mature students often felt they had an edge in relation to study skills. Previous study or work experience helped them to know what was expected and how to perform under pressure, allowing them to focus on making sense of new knowledge.

By having a previous bachelor's degree, I've got a better understanding of the expectations. And I can see that when I look at it again, some of the younger ones that haven't done any kind of university learning, that they stumbled initially to understand that there was this whole new level of professionalism expected out of their work.

People skills

Participants were very aware of the human component of osteopathy and recognised the importance of people skills, which included being able to connect with people from all walks of life, build rapport and being comfortable around people. Eight participants spoke about these skills. There was a strong recognition of a need to be seen as professional, confident and knowledgeable to build trust. People skills could be developed through work experience, life experience and social involvement, for example sports.

As long as you can handle the academic side of things, it's probably more important in the profession to be able to relate to the customers.

Personal qualities

Personal qualities outside of content knowledge or skills were seen as a key component of success for several participants. These qualities were generally seen as innate, but could be developed over time.

Motivation

Seven participants spoke about motivation. Participants acknowledged that osteopathy was a difficult programme of study and as a result, a drive to complete the qualification and overcome challenges was seen as essential. Participants felt that it was important to assess motivation when considering prospective students. This could be demonstrated by passion for the programme, academic success or interest and success in sport. Motivation was also linked to entry criteria, where it was seen as more relevant for prospective students to study subjects they were passionate about rather than sciences.

... it's not difficult stuff, it's just more the drive and if you've got a previous interest in this kind of stuff, you'll stick around longer.

Life experience

No significant correlation (positive or negative) was found between the age of the student and their mean Total GPA. A weakly positive correlation was noted, however, between the number of years since the student had last studied and their mean Total GPA ($r_s = 0.259$, $p < 0.05$), which accounted for 7% of the variation in mean Total GPA. Students who had been away from study for two or more years before enrolment in the degree showed a higher mean Total GPA ($M = 5.52$, $SD = 1.37$) than those who had studied more recently ($M = 4.42$, $SD = 1.55$); $t(57) = 2.68$, $p = 0.01$.

The idea of life experience was woven through many aspects of the interviews, with seven participants speaking to this theme. This

was synonymous with maturity and for many was instrumental to success. Life experience and maturity were seen to enhance time-management and study skills and in some cases overcame barriers that not having recently studied science might present. It was also viewed as key in interacting professionally and appropriately with clients. Finally, participants strongly linked life experience to motivation; it allowed students to know that they really wanted to study osteopathy and be willing to make the commitment and sacrifice to undertake intensive study. Although life experience was not always related to age, taking a break between school and study (e.g. through travel or work) was seen as helpful in order to develop an adult identity and be ready for study and the career.

So I think my maturation has come more from life experience, being in situations where I've been thrown in the deep end with responsibilities and then having to manage that. So that would be where most of my kind of understanding and the importance and the relevance of what we're learning comes from, and that, I think, makes it easier to learn.

Confidence

Confidence was discussed in nine interviews. This came from a range of places including familiarity with sciences, people skills, life experience, identity, motivation, determination and academic skills. For a number of participants, it was important to have at least one area in which they felt confident, to support them in other areas, or recognise where they needed to focus their time and energy.

To me, there's sort of two ways you could come at this my feeling is, that you need to have one or the other [Science or other experience].

Students who did not come with confidence, or lost their confidence, struggled with their studies. This had to be actively overcome to succeed.

I kinda lost that [confidence] coming into this because I had a few bad grades and then I was like "Oh my God, I'm so overwhelmed".

Discussion

Is previous study of science perceived as useful?

The results of this study suggest that previous study in the sciences may be of limited value for students embarking on an osteopathy programme. Biology seems to be of greater value than other sciences, although still only accounting for around 9% of the variance in outcome, and even then only for first semester studies. Given the preponderance of science-based subjects (especially biological sciences) in the early part of the osteopathic programme, it is perhaps surprising that there is not a stronger correlation between previous studies in this area and subsequent success.

Some students may have prior knowledge of biology through other means, for example through related subjects such as Sports Science, or through informal experience. Participants found 'body knowledge' (an awareness of the body through other experiences such as sport or massage) to be helpful. The current study did not include related subjects and did not capture experiential knowledge, which could partly explain the low correlation with biology. However, this would not account for the benefit being so short-

lived. The finding that high school biology incurred no advantage beyond the first semester suggests that students with no prior biology are either able to compensate through other means and this was borne out by participants, who were themselves ambivalent about the value of pre-entry study of sciences. In particular, there was a perception that while sciences may confer an early advantage in terms of content knowledge, other study or experience can be equally beneficial and so those without formal science qualifications are not seen to be disadvantaged.

Opinion in the literature is divided with regard the value of specific subjects as predictors of future academic performance and there seems to be a stronger correlation between overall GPA prior to entry and subsequent success, rather than with achievement in individual subjects [7,12]. However, in a British study, Wharrad, Chapple and Price (2003) [18] found that the number of subjects previously studied provided a stronger predictor than GPA, hypothesising that the positive (but small) correlation between number of 'A' grades at O-level/GCSE and performance in a nursing degree might be a reflection of students demonstrating talent across a broad range of topics. The ambiguity about the value of pre-admission qualifications reported both in this study and in the literature suggests that other factors may be involved in determining success in osteopathic studies.

What other factors are at play?

Participants identified other factors as being just as important as the subjects studied through formal qualifications.

Skills

English or English-rich subjects were not found to be significantly correlated with success in the programme, but participants did perceive such subjects as being helpful and the benefit seems to be skills-rather than content-based. The value of good study skills came across strongly from participants: this could take many forms, from effective time management to an ability to analyse questions and structure formal writing. The medium correlation between highest level of study (regardless of subject) and first semester performance could in part be due to students having already developed skills for successful study, since study skills may of course have been gained from any number of subjects within formal education as well as through other life and work experience.

Personal qualities

Participants perceived innate personal qualities such as internal motivation and confidence to be important for successfully navigating the demands of studying osteopathy. The importance of confidence came across from most participants. The area of confidence does not seem to be important; simply the fact of being confident in one aspect of their studies was seen to be key. Thus, a student might be struggling in one area, but felt able to manage because they were confident in another aspect of the programme.

These findings are supported by Ref. [14]; who suggested that the relationship between pre-admission qualifications and subsequent success might be due not only to content knowledge, but also to advanced study skills developed prior to commencing tertiary study, or to higher confidence levels based on prior achievements [9]. also proposed alternative perspectives, suggesting that high achievement prior to entering medical school could be an indicator of high levels of motivation and this, rather than the content knowledge, might account for the predictive value of pre-entry qualifications.

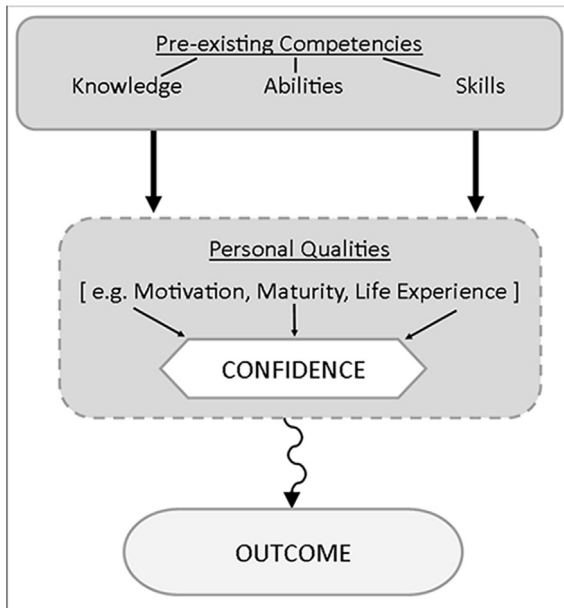


Fig. 1. Model for student success.

The interplay between knowledge, skills and innate personal qualities

The analysis of the qualitative data suggests that the application of pre-existing student competencies (such as content knowledge, skills and abilities) are influenced by personal qualities. The researchers hypothesise that personal qualities can act as mediators of success within the programme. This hypothesised relationship is depicted by the model in Fig. 1.

In this model, we are proposing that the extent to which outcome is influenced by students' prior knowledge and skills is affected by innate personal qualities, such as confidence, maturity and motivation.

As discussed above, while a high level of knowledge in biological sciences is not necessary for success, participants identified the need to have some area of strength in either prior knowledge (such as such as previous study or experience in the sciences) and/or skills (such as structured writing, strong study skills or interpersonal skills) in order to manage the change to a new discipline. While strength in such 'competencies' is important, participants also stressed the importance of more abstract factors (or personal qualities), such as maturity and motivation, which serve to engender a sense of self-confidence in the student.

Here, it is proposed that these competencies and personal qualities act as a complementary system, with the personal qualities modifying the ability of a student to apply their prior knowledge and skills to their study (or to remedy areas of weakness), but with the pre-existing competencies also affecting the expression of a student's self-confidence. A student with strong prior knowledge may be hindered by a lack of motivation, maturity or self-awareness whereas, conversely, a student with a lack of prior knowledge may be able to overcome this due to a high level of dedication and confidence in their ability to succeed. This suggests that the existence and development of these personal qualities are just as vital to success as the academic knowledge a prospective student brings with them.

Limitations

This study was limited to students from one osteopathic

programme and included a relatively low number of students. The extent to which the results can be extrapolated to other osteopathic programmes is therefore limited without further research.

Only students who had continued into later stages of the programme were included in the second part of the study. This represents a significant limitation to the study as the perceptions of students who did not continue with their osteopathic studies were excluded.

The study only focused on the success of students in the first year of the programme and does not necessarily reflect success in later years of study.

The quantitative data presented in this study serves to support the qualitative findings. However, the limited amount of quantitative data gathered and the method of analysis carries a risk of Type One error. Further investigation would be required to substantiate the accuracy of these results.

Conclusion

The use of previous qualifications as admission criteria is widespread and provides a relatively easy system of selecting students for the programme [13]. However, the findings of this study suggest that caution should be applied in placing too much value on entry qualifications and that other factors need to be taken into account, such as life experience, prior skills and work experience.

Future research

This was a small scale study into the relationship between pre-admission qualifications and successful completion of the first year of study in a single osteopathic programme. Further research might seek to test the model proposed in this study across multiple osteopathic programmes.

In the light of the findings of this study, further investigation of the possible merit of Biology-related subjects such as Sport Science, as well as informal knowledge of the human body (for example through massage training or participation in sport) would be helpful.

The benefit of other indicators such as participation in sport or mastering a musical instrument might be useful areas for further study.

Implications for practice

If the model presented in this study is found to be applicable and relevant across a wider range of osteopathy programmes, applications could be assessed against multiple criteria rather than the narrow focus of formal qualifications. For example, admissions teams may give credit for success in biology and other sciences; academic success overall; and additional personal/professional experience and skills.

There are potential advantages in broadening admission criteria and admitting students to the programme with a wider mix of knowledge/skills-base, increasing the diversity of the student population and so ultimately of the profession. Broader admission criteria also present an opportunity for providing the richer learning environment afforded by more diverse student cohorts. The need to include a wider diversity of students in other areas of medical education is increasingly recognised, with proposals for looking at broader pre-admission criteria when selecting students [3]. It is possible that the findings of this study could be applicable to other health-related programmes.

If a requirement for prior study of sciences is waived, this will reduce the ability for faculty to assume pre-knowledge, or standardisation of knowledge across cohort. Although not

insurmountable, course designers and academic staff would need to take this into account, perhaps through diagnostic testing and early intervention/supplementary learning resources for those students without a science background.

Conflict of interest

None.

Funding sources

Funding was obtained from an internal New & Emerging Research Grant from the Faculty of Health & Social Sciences at Unitec Institute of Technology. Project Code: RI14050.

The sponsor played no role in the study design; in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the article for publication.

Ethics approval

Ethics Approval was awarded by the Unitec Research Ethics Committee.

File number 2014-1084.

Start date: 12.10.14 Finish date: 12.10.17.

Acknowledgments

The authors would like to acknowledge the contribution of the late Claire Tait to this study. Claire was an integral part of the research team and conducted the participant interviews.

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