Who is teaching science in our high schools?

Exploring factors influencing pre-service secondary science teachers’ decisions to pursue teaching as a career

Christine V. McDonald

A central objective of recent government reports focuses on the important role of education in preparing a skilled and dynamic science, technology, engineering and mathematics (STEM) workforce, with effective teaching in secondary STEM classrooms reliant on the engagement and retention of high-quality STEM teachers (Office of the Chief Scientist, 2014). This study sought to explore the factors influencing pre-service secondary science teachers’ decisions to pursue teaching as a career. Participants in this study were enrolled in undergraduate and postgraduate teacher education programs at a large, urban Australian university. A total of 12 pre-service teachers enrolled in a science curriculum course participated in the study. Analysis of interview data identified two key factors influencing their decisions, including their perceptions and experiences in high school, and a lack of opportunities in STEM-related fields. Other findings indicated participants expressed positive outlooks regarding their decisions to pursue teaching as a career, and articulated views of science and science teaching aligned with inquiry-based approaches in science education. Implications from this study suggest that, although these participants are likely to encourage students to consider teaching as a profession, they may not promote STEM-related professions as possible career paths, due to their previous experiences.
INTRODUCTION

Science, technology, engineering and mathematics (STEM) is a major emphasis in recent initiatives seeking to enhance economic prosperity via a highly educated workforce, both within Australia, and worldwide (Office of the Chief Scientist, 2014; Riegle-Crumb, King, Grodsky, & Muller, 2012). Many countries have invested significantly in STEM educational initiatives largely driven by concerns about future potential shortfalls in STEM-qualified professionals (van Langen & Dekkers, 2005). In Australia, robust performance in STEM is considered a key imperative, as the education sector is the fourth largest export industry in the country. In a recent report commissioned by the Office of the Chief Scientist (2014, p. 20), a central objective focuses on the important role of education in preparing a skilled and dynamic STEM workforce. Achieving these objectives will require: (1) strong STEM teaching at all levels, supported by high-quality and relevant teacher training and subject-specific professional development; and (2) increased numbers of subject-qualified STEM teachers in Australian schools.

Step Up! Transforming mathematics and science pre-service secondary teacher education in Queensland is one of five, large-scale projects funded under the Enhancing the Training of Mathematics and Science Teachers (ETMST) program. The ETMST program was developed in response to concerns highlighted in 2012 by former chief scientist, Professor Ian Chubb, regarding issues with retaining secondary and tertiary students in the STEM pipeline. A core aim of his proposal focused on increasing the number of STEM-qualified graduates over the next generation, in addition to enhancing the scientific literacy of all students. As one of the five projects funded to address these concerns, the Step Up project (2013–2016) was developed to effect step-change in courses, partnerships, academic practice and recruitment of students to teacher education in order to transform the nature and delivery of science and mathematics pre-service secondary teacher education in Queensland. This paper reports on a study conducted to investigate factors relating to the recruitment of students into teacher education.

SECONDARY SCIENCE TEACHERS

The critical role of the teacher in fostering positive attitudes towards science (Office of the Chief Scientist, 2012), and influencing decisions to study science (Venville, Rennie, Hanbury & Longnecker, 2013) cannot be overemphasised. Indeed, Hattie (2012) posited that high-quality teachers are the single most important influence on educational achievement in schools. Teachers are considered to play a pivotal role in students’ learning and achievement via engagement in effective pedagogical practices, and the provision of a safe and supportive learning environment (Elster, 2014; Lasley, Siedentop & Yinger, 2006).

Studies have shown that teachers’ attitudes and beliefs influence their decisions and practices, including their implementation of new pedagogical practices, classroom planning activities, and involvement in professional decision-making (Apostolou & Koulaides, 2010; Dixon & Wilke, 2007; Lee, Hart, Cuevas & Enders, 2004). Other research suggests that teachers’ personal experiences, including their previous school, and professional and life experiences, impact on their beliefs about teaching (Forbes & Davis, 2010; Pajares, 1992). In turn, students’ attitudes towards science have been shown to be heavily influenced by teachers’ attitudes and beliefs (Hattie, 2009).

Effective teaching in secondary science classrooms is reliant on the engagement and retention of high-quality science teachers, with research highlighting problems in recruiting science teachers for over two decades (McKenzie, Weldon, Rowley, Murphy & McMillan, 2014), and evidence indicating 40% of teachers leave the profession within five years of graduating (Paris, 2013). A significant problem relates to the status of teaching as a profession, with recent studies reporting that high-performing students who enrol in STEM subjects are not choosing to pursue teaching as a career (Office of the Chief Scientist, 2014). In addition, students who choose to enrol in STEM subjects—such as science—in secondary school, tend to make these decisions to aid entry into tertiary courses, as achieving highly in...
these subjects generally facilitates higher tertiary entrance scores (Bøe, Henriksen, Lyons & Schreiner, 2011). Secondary students also have a wide range of options available for tertiary study, creating a competitive environment for individual subject choice (Lyons & Quinn, 2010).

Thus, as an important step in the process of transforming pre-service secondary science teacher education, it is vital to explore the factors influencing pre-service teachers’ decisions to pursue teaching as a career. Why do they choose to become science teachers? What are their backgrounds? What are their perspectives about science and science teaching? Will they encourage their students to become STEM professionals? What can they contribute to the science teaching profession? This study will attempt to address some of these important questions, with findings from the study adding to our understanding of the nature of the science teachers about to enter the teaching profession. The following research questions will be addressed.

1. What are pre-service secondary science teachers’ previous experiences of science and science teaching in high school?
2. What are pre-service secondary science teachers’ reasons for pursuing teaching as a career?
3. What are pre-service secondary science teachers’ current views of science and science teaching?

METHOD

A qualitative methodology was utilised in this study to explore the factors influencing pre-service secondary science teachers’ decisions to pursue teaching as a career. Ethical approval to conduct the study was obtained from the relevant university’s ethics committee.

Setting and Participants

This study was conducted with 12 pre-service secondary science teachers (seven female, five male) enrolled in a science curriculum course offered at a large, urban university in Queensland, Australia. Three pre-service teachers were enrolled in a four-year undergraduate Bachelor of Secondary Education program, and nine pre-service teachers were enrolled in a one-year Graduate Diploma of Education—Secondary program. The science curriculum course was designed to provide both undergraduate and postgraduate pre-service teachers with inquiry-based, science-based pedagogical content knowledge to enable them to develop engaging, flexible and challenging science material for junior secondary (Years 7–10) science classrooms. In the course, pedagogical content knowledge is developed through an exploration of key foundational scientific concepts and processes, science teaching strategies and learning experiences, lesson and unit planning, assessment strategies, and literacy/numeracy/ICT integration.

The nine-week course is the first science curriculum course participants undertake in their programs, and is taken in the first semester of third year in the undergraduate program, and in the first semester of the single year in the postgraduate program. At the conclusion of the course, pre-service teachers undertake their first 5–6-week, school-based practicum.

Sixteen pre-service teachers consented to participate in the study from a total course enrolment of 53 (17 undergraduate and 36 postgraduate) pre-service teachers. Due to the intensive nature of the data collection for the study, two pre-service teachers were not interviewed due to time constraints. Another pre-service teacher left the course, and one pre-service teacher did not attend the majority of classes, leaving a total of 12 participants. Profiles of the participants are outlined in Table 1 (pseudonyms have been used for all participants in this study).
Data sources and analysis

Interviews were the primary data source in this study. Participants took part in individual semi-structured interviews during Week 2 and Week 3 of the course. These interviews were conducted by the researcher, and took place during scheduled laboratory classes, in the laboratory preparation room. The average duration of each interview was 20 minutes.

The semi-structured interview protocol consisted of two sections. The first section sought biographical information from participants including their age, degree program, teaching areas, academic qualifications and school science education; as well as additional information including: reasons why participants had chosen to undertake a teaching degree, participants’ previous work and educational experiences, career aspirations when they left school and life experiences that influenced their choices. The second section sought to ascertain their views about science and science teaching, and included questions such as how they defined science, how science is different from other disciplines, whether there is a single ‘scientific method’, and whether particular science disciplines are more important or privileged over others. Participants were also asked if they had any additional questions at the conclusion of their interviews, and all interviews were audiotaped using a digital recorder.

Interviews were fully transcribed for analysis at the conclusion of the study. Pre-determined categories were not used to group responses; instead, categories originated inductively from the data. The coding process consisted of initially reading through all 12 transcripts and generating a set of categories which encompassed all responses. Three broad categories (encompassing a number of sub-categories) represented the central themes that emerged from the data, and the findings of the study were organised around these identified themes.

FINDINGS

This study sought to explore the factors influencing pre-service science teachers’ decisions to pursue a career in teaching. Analysis of the data identified two key factors influencing their decisions, including: (1) their perceptions and experiences in high school, and (2) a lack of opportunities in STEM-related fields (including personal and lifestyle factors). The majority of participants expressed positive outlooks regarding their decisions to pursue teaching as a career, and articulated views of science and science teaching that aligned with inquiry-based approaches in science education. In general, participants were hesitant to privilege individual science disciplines (including their own science teaching areas) over others, and recognised the importance of all areas of the science curriculum to science education as a whole. These findings will be discussed in more detail in the following subsections.

Table 1. Profiles of participants.

<table>
<thead>
<tr>
<th>NAME</th>
<th>AGE</th>
<th>ACADEMIC QUALIFICATIONS</th>
<th>TEACHING AREAS</th>
<th>PREVIOUS EDUCATION/WORK HISTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natasha</td>
<td>19</td>
<td>Nil</td>
<td>Chemistry, Maths</td>
<td>School leaver.</td>
</tr>
<tr>
<td>Narelle</td>
<td>22</td>
<td>Nil</td>
<td>Biology, Maths</td>
<td>Commenced health science degree (discontinued).</td>
</tr>
<tr>
<td>Eddie</td>
<td>32</td>
<td>AdvDip Civil Engineering</td>
<td>Biology, Music</td>
<td>Worked as a drafter and in graphic design. Committed B Psychology (discontinued).</td>
</tr>
</tbody>
</table>
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Looking back—Perceptions and experiences in high school

Participants were asked about their experiences in high school regarding teaching (in STEM-related subjects) as a career, reasons for choosing STEM-related subjects in Years 11 and 12, differences in how subjects were presented, whether biases existed, and whether certain careers were privileged by teachers or parents. Common themes that emerged from these discussions included:

1. teaching discouraged as a career path,
2. expectations and/or pressure to enter particular professions, and
3. preferences for individual STEM subjects.

Firstly, three participants (Narelle, Brian and Susan) were discouraged from selecting teaching as a career option whilst in high school, and encouraged to pursue a more ‘academic’ career path. Narelle was a 22-year-old undergraduate pre-service teacher who stated that she had always wanted to be a teacher from as early as she could remember, however, she was put off the idea in Year 12, “... everybody said teachers are overworked, they’re underpaid, don’t do it. I got talked out of it and everyone’s like you’re so smart, what you’ve got to do is science ...”

Similar perspectives were expressed by Susan, a 26-year-old postgraduate pre-service teacher, who stated that teaching “... wasn’t the academic thing. So, if you did well, you didn’t need to be a teacher.” Brian, a 23-year-old postgraduate pre-service teacher, had a similar experience and stated, “Even teachers say don’t be...”

Table 1. Profiles of participants (continued).

<table>
<thead>
<tr>
<th>NAME</th>
<th>AGE</th>
<th>ACADEMIC QUALIFICATIONS</th>
<th>TEACHING AREAS</th>
<th>PREVIOUS EDUCATION/WORK HISTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brian</td>
<td>23</td>
<td>B Engineering (Civil)</td>
<td>Physics, Maths</td>
<td>Did not work as engineer. Worked as sports coach.</td>
</tr>
<tr>
<td>Nick</td>
<td>26</td>
<td>B Aviation</td>
<td>Integrated Science, Maths</td>
<td>Finished degree one year ago. Worked as retail manager.</td>
</tr>
<tr>
<td>Faith</td>
<td>26</td>
<td>BSc (Chemistry, Microbiology)</td>
<td>Chemistry, Maths</td>
<td>Worked in petrochemical mining industry.</td>
</tr>
<tr>
<td>Simone</td>
<td>31</td>
<td>BSc (Biomedical)</td>
<td>Chemistry, Biology</td>
<td>Worked in private microbiology lab. Commenced health-science-law degree (discontinued), commenced law degree (discontinued). Worked in population health.</td>
</tr>
<tr>
<td>Jodie</td>
<td>42</td>
<td>BSc (Biomolecular)</td>
<td>Chemistry, Maths</td>
<td>Commenced nursing degree (discontinued). Commenced science degree with clinical science major (exited with biomolecular major one year ago).</td>
</tr>
<tr>
<td>Cam</td>
<td>46</td>
<td>BSc (Environmental)</td>
<td>Integrated Science, Geography</td>
<td>Qualified chef, worked in hospitality and hotel management. Qualified commercial skipper, worked in marine tourism. After degree worked in coal seam gas industry.</td>
</tr>
<tr>
<td>Susan</td>
<td>26</td>
<td>BSc (Zoology) Hons I</td>
<td>Biology, Chemistry</td>
<td>Worked in computing. Commenced PhD (discontinued). Worked at call centre.</td>
</tr>
<tr>
<td>Matt</td>
<td>33</td>
<td>BSc (Physics) Hons I, PhD (Climate modelling)</td>
<td>Physics, Maths</td>
<td>Worked in tourism for 3 years after honours. Worked as postdoctoral researcher in two institutions (USA and Australia).</td>
</tr>
<tr>
<td>Ursula</td>
<td>40</td>
<td>B Mathematics, M Physics, PhD (Physics)</td>
<td>Physics, Maths</td>
<td>Worked as postdoctoral researcher in three institutions (Australia and overseas), worked as geophysicist. Worked as a school tutor.</td>
</tr>
</tbody>
</table>
a teacher … I remember them saying don’t be a teacher.” Interestingly, Natasha (19 years old) was the only participant in the study who entered her teaching degree directly after finishing high school. She expressed that she always knew she was going to be a teacher, and was not discouraged from choosing teaching as a career in high school.

The second identified theme related to expectations, with four participants (Brian, Matt, Faith and Susan) stating there were expectations on them to enter certain professions, particularly from parents. Brian stated, “… my parents had drilled it into me—wow you’re good at maths, you’re good at physics; keep doing this, you’ll love engineering.” He completed an engineering degree but did not enjoy it, and stated that he felt pressured to continue in the degree even when he knew he did not want to work in the profession. Matt, a 33-year-old postgraduate pre-service teacher had a similar experience, and entered a double degree in engineering and science when he finished high school. He stated that there were parental expectations on him to follow in his father’s footsteps to become an engineer. Similarly with Brian, he also wanted to drop engineering during his degree, however his father convinced him to continue until the end of second year when he eventually dropped engineering, and exited his degree with a Bachelor of Science. Faith was a 26-year-old postgraduate pre-service teacher of Indian ethnicity who completed her high school education in South Africa. She graduated top of her school, and her mother wanted her to do medicine. However, she did not receive a scholarship for medicine, and instead was offered a scholarship in science, she then went on to state, “I sacrificed medicine, which was my Mum’s dream, and decided to do science, which was my dream.”

The third theme to emerge from an examination of participants’ high school perceptions and experiences related to subject preferences. For example, two participants (Simone and Natasha) commenced physics in Year 11, but discontinued soon after. Simone was a 31-year-old postgraduate pre-service teacher who was completing chemistry and biology as her senior teaching areas. She stated that she did not like her physics teacher, and could not see the relevance of physics to real life, “… what a waste of my life, doing physics”. Natasha also dropped physics in Year 11 and was completing maths and chemistry as her senior teaching areas. She cited that she disliked the class because the physics teacher wasn’t able to explain concepts clearly, and “… it was a class full of boys.”

Other participants (Matt, Ursula and Nick) expressed that they had negative views of biology in high school. Matt and Ursula held PhD degrees in physics-related fields, and both disliked biology whilst in high school, citing the high degree of memorisation required in the subject, and perceived lack of challenge. Matt was completing physics and maths as his senior teaching areas, and had completed higher mathematics, physics and chemistry at high school. He stated that before Year 10 he had thought about doing biology however, ...

... when I got to Year 10 and they actually exposed us to biology, I wasn’t super interested in it … I just remember sitting there, in Year 10, and them drawing diagrams of cells and all of this stuff, and it was just like … I don’t need to know this. I don’t want to remember it … perhaps it was the style of learning. I guess there was a lot of just—I do a lot better with concepts. I don’t do very well with memorisation … I found biology was very much about—I guess, just pure knowledge …

Ursula was a 40-year-old postgraduate pre-service teacher of Indian ethnicity, who was completing physics and maths as her senior teaching areas. She stated that during high school she did not like biology at all, “I didn’t like the fact that I had to memorise so much stuff … I was just very happy in my Year 10 exam because it was the last day I was going to study biology …” Interestingly, although she held doctoral qualifications in quantum physics, she expressed that she did not enjoy physics in high school, stating that the concepts were not explained clearly, and that she was unable to see the connections to her everyday life.
Road blocks—Reasons for pursuing teaching as a career

A variety of reasons were put forward by participants regarding their decision to complete a teaching degree. Only one participant (Natasha) was completing her degree straight from high school, with 11 participants returning to university study after time in the workforce. Two common themes emerged from a consideration of the evidence: (1) a lack of jobs in STEM-related fields, and (2) personal and lifestyle factors.

Five participants (Cam, Faith, Simone, Susan and Matt) stated that their decision to complete a teaching degree was due to a lack of jobs in STEM-related fields. Cam, a postgraduate pre-service teacher, was the oldest participant in the study (46 years old). He left school in Year 11 and qualified as a chef, and since that time has worked in a variety of jobs. More recently, he completed a Bachelor of Science, majoring in environmental science. After graduating, he worked in the coal seam gas industry until funding for his position ran out. Faith held a Bachelor of Science with majors in chemistry and microbiology, and had just received her permanent residency. She had not been able to find a job in her field since arriving in Australia three years ago, and had sought employment in a variety of laboratories. Similarly, Simone held a Bachelor of Science, majoring in biomedical science, and although she had previously worked in a private microbiology laboratory, she could no longer find employment in a STEM-related field, “… there are no jobs. I applied for so many … You need an honours or a PhD …”

However, even participants who held honours or doctoral degrees expressed difficulty in finding employment in STEM-related fields. For example, Susan held a Bachelor of Science with first class honours in zoology. She chose to complete honours as she knew it would be competitive to gain employment in the zoology field, however she still could not find a job, “… there was not really a lot of hope … I even looked for jobs in zoos …” Matt expressed that he considered himself less-employable now due to being over-qualified. He completed his PhD in climate modelling, had worked as a postdoctoral researcher in both Australia and overseas, and had an extensive publication record. He stated that there were no jobs in STEM-related fields, “I see no future in academia or research science for myself … There’s just not the opportunities … It’s a global marketplace where you have a lot of highly intelligent, highly motivated people competing for a very small number of jobs.”

The second theme to emerge related to personal and/or lifestyle factors, with six participants (Eddie, Brian, Narelle, Nick, Jodie, and Ursula) citing these factors as influencing their decision to pursue a teaching degree. Nick was a 26-year-old postgraduate pre-service teacher who completed a Bachelor of Aviation, but due to a variety of reasons, including: keeping up his flying hours, having to work on the side to support his family, and anxiety issues, he was unable to realise his goal of becoming a pilot, “It’s more so the one job that I ever wanted in the world that I worked six years for. I put too much pressure on myself …” A similar situation was voiced by Jodie, a 42-year-old postgraduate pre-service teacher. Jodie had worked in a variety of jobs since leaving high school. More recently, she completed a Bachelor of Science majoring in biomolecular science, however she transferred out of the advanced program to graduate instead of going on to complete honours due to high anxiety. As she didn’t complete honours, she stated she was not likely to get a job in the field.

Ursula highlighted lifestyle factors as influencing her decision to pursue a teaching degree. She held a PhD degree in physics, had completed three postdoctoral positions in Australia and overseas, and had published a number of papers. She had three children, and stated that working as a postdoctoral researcher was not compatible with raising a family: “Obviously when you’re doing a research project … it just completely becomes your life. So, my kids were really young at the time … even though they were in front of me—I would be thinking of my calculations. I was so passionate about it that … I didn’t give them 100 per cent attention …” She then decided to work in industry, but found there was no flexibility in her position to cater for her family needs, and finally decided to pursue a career in teaching to ensure she could accommodate her family responsibilities.
Regardless of their reasons for pursuing a teaching degree, the majority of participants expressed a positive outlook regarding their new careers. Two participants (Eddie and Brian), who stated they were bored in their previous engineering careers, said that they wanted to make a difference in students’ lives. For example, Eddie, a 32-year-old postgraduate pre-service teacher, expressed interest in adolescence development, and Brian highlighted “… If I can just help one student at a time, at the end of the day, inches make miles.”

Other participants expressed a desire to share their knowledge. Matt had gained some teaching experience at the tertiary level, and although he admitted he still held reservations about his decision to pursue secondary teaching, he stated,

I do think I am genuinely interested in teaching and conveying knowledge and scientific literacy … I feel quite strongly about scientific and mathematical literacy … I am trying very hard to see it as a sideways move that’s opening up a lot of new and exciting opportunities.

Faith had also gained some experience in teaching, having recently worked in an after-school program in which she had been encouraged to pursue teaching as a career. She drew on her religious beliefs to support her decision:

I’m very passionate about science and I always thought I’d have a career in research, but I think having that religious foundation showed me how important transmitting knowledge is; because in Islam, transmission of knowledge is very highly regarded, and transmission of correct knowledge is highly regarded. So, I thought that I could use both in terms of my values and my love for science in teaching.

Other participants were more pragmatic in their views, highlighting job security as an important factor in their decision-making. For example, Susan wished to participate in competitive sport, and recognised that teaching would allow her to pursue this goal, as she viewed teaching as “a standard job”. Nick had been working in retail since finishing his aviation degree, and highlighted the advantages of teaching as a career, “It’s a job that’s going to be around forever … It’s a job that pays well … they take holidays at Christmas.”

Going forward—Views of science and science teaching

An important consideration in the study was to explore participants’ views of science and science teaching to ascertain whether they aligned with inquiry-based approaches in science education. A variety of responses were provided by participants when asked how they would define science, with many responses focusing on how science enables an understanding of the world, and how things work. For example, Susan stated, “I think it’s about finding out about the world and the universe and everything, trying to figure out why …” Other participants highlighted the questioning nature of science, with Nick stating that “… scientific exploration is all about seeing something and then questioning it. That’s what science is, it’s having a curiosity to be able to search for more answers.” Other participants drew attention to the context that science operates in, with Eddie noting, “I’m aware of the political and social implications and the religious ramifications of science.”

The majority of participants did not subscribe to the naïve view that science follows a step-wise method. For example, Jodie drew attention to the creative nature of science in her response:

But if you are—as I was saying about being dogmatic—you may miss stuff. I believe that a lot of the developments that people have made—well it’s not the eureka moment … Like penicillin with the mould growing and stuff like that. A lot of it’s just noticing something that’s a little different that you didn’t expect.

Matt referred to his previous research experience in his response, “I do a lot of theory. My wife does observations and experiments. The way that our scientific methods are very different … It’s more about formulating a methodology that’s appropriate to answering the question that you’re asking.”

In order to ascertain how the nature of the individual scientific disciplines might be conveyed to their future students, participants were asked for their views about the importance of the individual disciplines, whether certain disciplines were more important or privileged than others, and if there were any substantial
differences in how the disciplines were conducted. In general, participants were hesitant to privilege particular science disciplines (including their own science teaching areas) over others, and recognised the importance of the individual disciplines to science education as a whole.

Interestingly, although the three undergraduate pre-service teachers (Natasha, Narelle and Eddie) stated that they didn’t privilege particular disciplines over others, they highlighted how some of their fellow undergraduate education colleagues expressed privileged views of physics and chemistry. For example, Narelle stated, “I, as a biology teacher, hang out with my other friends in maths who are also science—second science—and they’ll have physics and chem and they’re always like, you’re not a real science teacher…” Eddie also noticed these perceptions in his fellow colleagues, and attributed these views to their younger age and lack of experience.

These perceptions were also recognised by some postgraduate participants who highlighted that although they held privileged views of their discipline when they graduated from their science degrees, these views had now changed. For example, Matt stated,

*I used to bait my friends in chemistry by saying—and biology, really—everything is just physics… Whereas, now, I think it’s more—my opinion has matured more, to have a greater understanding of the interconnectedness of the different disciplines and the value … and the contributions of all of the various disciplines.*

Interestingly, other postgraduate participants nominated other disciplines as being more important than their own discipline. For example, Brian (senior teaching areas physics and maths) stated,

*I personally feel as though biology is the most important, even though I don’t get it. … I think when it comes to biology it’s your medicine, your health. While physics and chemistry can have that part where technological advances and things like that—I think that we’re so technologically advanced as it is that the next step is to get rid of diseases, cancers, all that sort of stuff.*

Although Ursula expressed that she considered physics more complex than the other science disciplines, due to its abstract nature, she did not feel her discipline was more important, “I think everything complements each other.”

Two participants highlighted the importance of making school science more relevant to young people. Simone drew attention to the importance of offering environmental science in high school, “… when you go out into the real world and see what petrochemicals are doing … environmental degradation … we can see it, but we don’t understand, we’re not teaching the foundation of what’s going on behind it and why it’s happening like that.” Cam expressed concern with the lack of relevance of traditional science subjects in high school:

*Is it not correct that people have been losing interest in science and yet all the curriculum does is push biology, chemistry and physics? So, they’re somehow saying it’s the teachers to blame. It’s not, it’s the content material, people don’t relate to it … You get better engagement with students, obviously, with more relevance … To me it’s the science for the everyday man …*
DISCUSSION AND IMPLICATIONS

A number of questions were posed at the beginning of this study regarding the nature of science teachers about to enter the teaching profession: Why do they choose to become science teachers? What are their backgrounds? What are their perspectives about science and science teaching? Will they encourage their students to become STEM professionals? What can they contribute to the science teaching profession? Evidence from this study suggests perceptions and experiences during the high school years were pivotal in influencing decisions made by participants when choosing tertiary courses. Findings indicated parents and teachers conveyed implicit (and often explicit) messages to participants regarding the status of teaching as a profession, and preferences to enter particular STEM fields, such as engineering or medicine. These findings are consistent with previous research which found that experiences as students were a powerful antecedent to the formation of beliefs about teaching (Crawford, 2007; Pajares, 1992).

As such, it is critical for our future teachers to convey informed views of science and science teaching to their students, as the development of scientifically literate citizens is a key goal of 21st century science education across the globe (Tytler, 2007). Encouragingly, evidence from this study indicates that our future teachers are in a good position to do this, with the majority of participants articulating views of science and science teaching aligned with inquiry-based approaches in science education. Inquiry-based approaches to learning are active pedagogical strategies that develop students’ abilities to ask questions, design investigations, solve problems, interpret data and evidence, form explanations and arguments, and communicate findings. The implementation of an inquiry-based curriculum incorporates a range of scientific experiences designed to explicitly facilitate and scaffold students’ engagement in inquiry practices such as planning investigations, and providing evidence for claims (McNeill, Pimentel, & Strauss, 2013). In addition, participants in this study recognised the importance of the individual disciplines to science education as a whole, and expressed positive outlooks regarding the importance of science teaching as a profession. As such, these future teachers are less likely to present a privileged view of individual disciplines to their students, and are also more likely to encourage students to consider teaching as a profession.

Other findings from the present study highlighted the demands required in some STEM professions, and associated constraints for participants who expressed a desire to find an optimal work–life balance. These findings are consistent with recent research which suggests that factors including commitment to parental responsibilities, ’making a difference’, career security, and other personal factors influenced pre-service teachers’ decisions to pursue a teaching qualification (Anthony & Ord, 2008; Grier & Johnston, 2009).

However, evidence from this study highlighted the majority of participants chose to enter their teaching degrees due to a lack of opportunities in STEM-related fields. Regardless of whether participants held bachelor degrees or doctoral degrees, a lack of jobs in STEM-related fields was a consistent finding in this study. These findings stand in contrast to current government agendas driven by concerns about shortages of STEM-qualified professionals. Interestingly, the Office of the Chief Scientist (2014, p. 21) recently reported,

Australia has limited statistics and information on the development and placement of STEM graduates into the workforce, their integration into the economy, and the projected demand for STEM-skilled employees. Without this knowledge, Australia lacks sufficient understanding of what the economy needs from the education system.

Importantly, some of the participants in this study can be described as “career-change” teachers. Watters and Diezmann (2015) describe career-change teachers as beginning teachers who hold advanced STEM qualifications and have worked in a STEM profession for an extended period. These teachers constitute a small yet important group of teachers, as recent government agendas highlight the need for the recruitment of high-quality candidates into the teaching profession (Office of the Chief Scientist, 2014). Watters and Diezmann highlight the perceived advantages of these teachers, including “the experiences that ex-scientists and engineers bring from their professional life including applied knowledge of their
subject matter, people-oriented skills, eagerness to share with colleagues, good communication skills and tolerance of diversity” (2015, p. 164). However, findings from their study suggested that career-change teachers faced a number of challenges as beginning teachers, including being overlooked by administrators and colleagues, and not establishing supportive relationships, which ultimately led to attrition from the profession.

Implications from the findings of the present study and previous research draw attention to the possibility of these future teachers presenting mixed messages to students. Although these teachers are likely to encourage students to consider teaching as a profession, evidence from the present study suggests they may not promote STEM-related fields as possible career paths due to their previous experiences. Further, Snyder, Oliveira and Paska (2013) assert that these teachers may experience considerable internal conflict whilst attempting to reconcile their previous professional identities with their new identities as teachers. Couple this with a possible lack of support from administrators and colleagues, and a number of concerns are raised.

In conclusion, the process of transforming pre-service secondary science teacher education is multifaceted. Future science teachers in this study were, by and large, highly qualified professionals with positive views of science and science teaching, bringing with them a wealth of knowledge from their everyday lives and previous employment. Whether these teachers will be able to promote STEM-related professions to their students, due to their previous career experiences and personal beliefs, remains an open question. Importantly, the results of this exploratory study are applicable to the 12 participants who took part in this study, and further research is needed to determine whether they apply to other participant groups.

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