How can Preservice Teachers be Measured against Advocated Professional Teaching Standards?

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Abstract

Australia has had many inquiries into teaching and teacher education over the last decade. Standards for teaching have been produced by national education systems with many state systems following suit. The Queensland College of Teachers (QCT) advocates ten professional teaching standards for teachers and preservice teachers. How can preservice teachers be measured against advocated professional standards? This study investigated 106 second-year preservice teachers' perceptions of their development against the QCT standards. A pretest-posttest survey instrument was developed based on the QCT standards and administered to these preservice teachers before and after their science education coursework. Percentages, ANOVAs and t-tests were generated to analyse the results. Findings indicated that 22 of the 24 paired pretest-posttest items were highly significant ($p<.001$). Percentage increases ranged from as low as 27% in the pretest to as high as 97% in the posttest, however, there were two items with lower significance (i.e., working in professional science education teams and supporting students' participation in society). Understanding preservice teachers' perceptions of their abilities to implement these standards may be a step towards the process of determining the achievement of teaching standards; however, more rigorous measurements will need to be developed. University coursework and related assessments can provide an indication of achieving these standards, especially authentic assessment of preservice teachers' practices.

Australia has had many inquiries into teaching and teacher education over the last decade (e.g., Bradley, Noonan, Nugent, & Scales, 2008; Commonwealth of Australia, 2005; Nelson, 2002; Ramsey, 2000). These inquiries focus heavily upon teaching standards, with some advocating minimum requirements to meet these standards, such as The Top of the Class Report (House of Representatives Standing Committee on Educational and Vocational Training, 2007). Other countries have also worked towards determining teaching standards, including standards related to specific subject areas such as science education (e.g., Bybee & Champagne, 1995; Collins, 1998). Each review presents recommendations for advancing teaching standards and/or provides an account of what is required for effective teaching. For instance, one report on teaching science in the US states, "effective science teaching is more than knowing science content and some teaching strategies. Skilled teachers integrate their knowledge of science content, curriculum, learning, teaching, and students" (National Research Council, 1996, p. 62); Australia later presented its own set of science teaching standards (National Science Standard Committee/ Australian Science Teachers' Association, 2002). Indeed, various Australian states now outline specific teaching standards.

The Queensland College of Teachers (QCT, 2009) has advocated ten professional standards for teachers. About a third of these standards focus on designing learning experiences. Such designs incorporate individuals and groups with standards emphasising engaging and flexible learning experiences. Effective learning environments present a range of opportunities for both collaborative and independent studies. These designs include the development of literacy and numeracy with intellectually challenging experiences that values student diversity. This recognises that teacher's pedagogical knowledge is essential for facilitating learning (Hudson & Ginns, 2007). In a constructivist approach, a teacher must be able to plan for teaching the subject through hands-on activities. This plan needs to encompass a variety of teaching strategies to structure a learning environment that encourages students to learn (Hassard, 2004).

About a third of the QCT standards are based on implementing these designed learning experiences. The implementation also incorporates assessment and reporting on students' learning. It shows that student engagement is key to learning. Undoubtedly, teachers need to know how to motivate students for learning (Pintrich, 2003). This requires instilling positive attitudes to motivate students towards the subject or topic. Although there are many ways to motivate students, and students have different internal mechanisms for self motivation, a teacher can motivate students by: (1) targeting their misconceptions about the topic or key concepts (e.g., Broek & Kendeou, 2008); (2) facilitating cooperative group work with interactive activities (Howe et al., 2007); (3) providing practical, real-world activities (Skamp, 2007); and (4) selecting high-impact teaching strategies (Hudson, 2007). Not surprisingly, teachers who have positive attitude towards teaching a subject can influence a student far more than those who have negative attitudes (Ediger, 2002). This positive attitude may be noted when the teacher displays enthusiasm for the subject. Numerous studies and educators (e.g., see Tauber & Mester, 2006, pp. 5-8) have shown that students are far more engaged in lessons where the teacher displays enthusiasm. Assessing students' learning of concepts and processes, and evaluating the teaching and learning environments must also be part of teaching standards.

Finally, about a third of the QCT standards focus on teachers' professional development and students' personal development. For teachers this means working effectively in professional teams, commitment to reflective practices and ongoing professional renewal. For students this entails personal development within safe and supportive environments, and assisting students' development by fostering positive student-teacher, parent-teacher and community-teacher relationships. Teachers need personal attributes within a professional environment that help to facilitate learning (Banner & Cannon, 1997; Vallance, 2000). Educators (Bandura, 1997; Pajares, 1997) contend that effective teachers display a self efficacy or confidence to teach, particularly with a commitment to lifelong learning. There is a relationship between teaching any subject matter and the teacher's attitude towards delivery of the subject (Nieswandt, 2005). Effective teachers reflect on their practices for improvement (Schon, 1983), part of which is working in professional teams and making commitments to professional development. Effective teachers update their pedagogical knowledge and content knowledge to assist students with current understandings on topics and key concepts (Hudson, 2006). The research question for this study was: How can preservice teachers be measured against advocated professional teaching standards?

Context for this study

This pretest-posttest study involved 106 second-year preservice teachers at an Australia university. Previously, they had been involved in a mathematics and science discipline unit, which focused on science and mathematics content knowledge. First semester units also included an introduction to education, teaching in new times, and learning networks using computers, while second semester units involved visual and verbal literacy, Indigenous education, active citizenship and wellness, health and physical education. They receive no school experiences as part of coursework in their first year.

These preservice teachers (n=106; 21% males, 79% females; 26% as mature-aged students) were involved in a one-semester science pedagogy course. The course structure involved a one-hour lecture, a one-hour tutorial, and a two-hour workshop each week. Lecture topics included: Constructivism; Conceptual change; Problem-based inquiry; Curriculum and instructional designs; Fusing curricula; Assessment and evaluation; and Designing science units of work. The tutorials concentrated on planning science lessons and science units of work while the workshops allowed for multiple hands-on experiences and first-hand scientific investigations across a wide range of topics (e.g., Earth science, astronomy, weather, life and living, natural and processed materials). Pairs of preservice teachers also facilitated a science lesson they had devised and organised to their peers, who provided anonymous written feedback (positive aspects of the lesson and aspects that require improvement). Both the science unit of work and lesson presentations were assessed as part of the coursework. Activities in tutorials and workshops highlighted a lesson structure, teaching strategies, questioning techniques, classroom management, and the use of technologies to facilitate hands-on science lessons.

Data Collection and Analysis

This study investigated 106 second-year preservice teachers' perceptions of their development as teachers using a survey based on Queensland College of Teachers' (QCT, 2009) professional standards (Appendix 1). Although there were 10 QCT standards, for the purposes of surveying these preservice teachers, items with two or more complexities were reconstructed as single items. For example, QCT (2009) standard one states, "Design and implement engaging and flexible learning experiences for individuals and groups" (p. 3). This standard had to be divided into single conceptual constructs. Hence, there were eight survey items from this one standard, viz: Design engaging science learning experiences for individuals; Design engaging science learning experiences for groups; Design flexible science learning experiences for individuals; Design flexible science learning experiences for groups; Implement engaging science learning experiences for individuals; Implement engaging science learning experiences for groups; Implement flexible science learning experiences for individuals; Implement flexible science learning experiences for groups. This separation recognises that designing and implementing are two different concepts, engaging and flexible may also mean two different things, and individuals and groups are different. In this way, the preservice teachers could respond to single concepts, which provided construct validity for the survey design. Although the first QCT standard was multifaceted, this varied between the standards with most standards separated into only two statements (Appendix 1).

These preservice teachers were involved in a Bachelor of Education degree. Pretest-posttest responses were recorded on a five-part Likert scale (strongly disagree to strongly agree and scored 1 to 5, respectively). This 26-item survey was administered as a pretest at the beginning of their science education coursework and then as a posttest at the conclusion of their science coursework, after they had completed designing their science unit of work and teaching science lessons to their peers. SPSS provided descriptive statistics (percentages, mean scores [*M*], standard deviations [*SD*]) to explain each item. Furthermore, an ANOVA was conducted with each pretest-posttest pair of items (i.e., *t*-test and *p* value, two-tailed significance). Using SPSS, a pretest item was entered with a posttest item for comparing means using a paired-samples *t*-test. A Cronbach alpha score tested for internal consistency as a reliability measure, where scores over .70 are considered acceptable (Kline, 1998).

Results and Discussion

Pretest-posttest data were analysed within the QCT standards. Findings indicated that 22 of the 24 paired pretest-posttest items were highly significant (p<.001; Table 1). The other two items were also statistically significant at a lesser score (p<.5, items 8 & 24). There appeared to be little difference in these preservice teachers' perceptions between designing engaging science learning experiences for individuals or groups (e.g., pretest=35%, 38%, posttest=95%, 97%, *t*-test -12.00, -11.80, respectively; p<.001, Table 1). These preservice teachers registered an increase in perceptions about designing flexible experiences in science education for individuals (30% to 85%) and groups (34% to 86%). There were similar percentage increases for designing science learning experiences that develop literacy and numeracy.

Table 1: Designing experiences in science education

Survey Item	Pretest			Posttest			ANOVA	
	M	*SD*	%*	*M*	*SD*	%*	*t*-test	*p* value
1. Engaging for individuals	3.16	0.86	35	4.24	0.53	95	-12.00	0.000
20. Engaging for groups	3.26	0.78	38	4.26	0.50	97	-11.80	0.000
13. Flexible for individuals	3.11	0.75	30	4.00	0.55	85	-12.66	0.000
23. Flexible for groups	3.07	0.72	34	4.01	0.54	86	-13.34	0.000
17. Develop language and literacy	3.21	0.81	39	3.97	0.58	82	-8.54	0.000
4. Develop numeracy	3.25	0.81	39	3.92	0.56	82	-7.74	0.000
7. Intellectually challenging	3.08	0.82	29	3.85	0.55	78	-9.05	0.000
10. Value diversity	3.26	0.81	35	3.85	0.63	79	-7.40	0.000

* =percentage of agreed and strongly agreed responses

Implementing engaging science learning experiences for individuals or groups were perceived similarly by these preservice teachers in both the pretest and posttest. However, posttest perceptions were significantly higher (t=-10.45, df=105, p<.001). Indeed, 54% more participants agreed or strongly agree that they could implement engaging science learning experiences for individuals and groups in the posttest (Table 2). This coincided with an increased perception for implementing flexible science learning experiences for both individuals and groups. Furthermore, there was little difference in perceptions for implementing engaging or flexible science experiences for individuals or groups. Likewise, those who believed they could implement science experiences to develop language and literacy were equivalent to those who believed the same for numeracy (Table 2). There were 76% who claimed they could implement intellectually challenging science experiences. This level of confidence may be expected as it would require teaching experiences and real-world knowledge of students to trial and determine where such experiences were challenging; similarly knowing whether one could implement science learning experiences that values diversity requires real-life contexts. Despite a posttest statistical increase for assessing and reporting in science education (p<.001), there were many who were uncertain that they could assess (28%) or report (32%) constructively on students' learning.

Table 2: *Implementing science*

Survey Item	Pretest			Posttest			ANOVA	
	M	*SD*	%*	*M*	*SD*	%*	*t*-test	*p* value
3. Engaging for individuals	3.25	0.81	39	4.15	0.51	93	-10.45	0.000
15. Engaging for groups	3.26	0.76	38	4.15	0.55	92	-10.18	0.000
19. Flexible for individuals	3.09	0.71	27	3.99	0.53	88	-12.22	0.000
25. Flexible for groups	3.14	0.75	31	3.99	0.54	89	-10.90	0.000
6. Develop language and literacy	3.25	0.74	36	3.87	0.57	79	-7.11	0.000
22. Develop numeracy	3.21	0.74	34	3.92	0.60	80	-8.09	0.000
9. Intellectually challenging	3.16	0.81	36	3.85	0.55	76	-7.55	0.000
11. Value diversity	3.21	0.74	31	3.85	0.65	73	-8,60	0.000
12. Assess learning	3.20	0.70	33	3.83	0.65	71	-7.15	0.000
14. Report on learning	3.36	0.72	47	3.77	0.65	67	-4.73	0.000

* =percentage of agreed and strongly agreed responses

Nearly all these preservice teachers indicated that at the conclusion of their science education coursework they could create and maintain safe and supportive science learning environments (Posttest: Item 18=96%, Item 21=97%, p<.001, Table 3). However, in the posttest analysis, many had not agreed or strongly agreed that they could foster positive relationships (23%), contribute to professional teams in science education (29%), or make a commitment to ongoing professional renewal in science education (23%), nevertheless these items were statistically significant (Table 3).

Table 3: *Personal and professional considerations*

	Pretest			Posttest			ANOVA	
Survey Item	*M*	*SD*	%*	*M*	*SD*	%*	*t*-test	*p* value
16. Support personal development	3.59	0.81	60	4.03	0.54	87	-5.40	0.000
8. Support participation in society	3.85	0.64	76	4.02	0.57	85	-2.13	0.036
18. Create a safe and supportive environment	3.99	0.74	82	4.42	0.57	96	-5.71	0.000
21. Maintain a safe and supportive environment	3.94	0.79	79	4.42	0.55	97	-6.05	0.000
2. Foster positive relationships	3.72	0.77	62	3.87	0.65	77	-1.60	0.000
24. Professional teams	3.32	0.85	41	3.82	0.67	71	-5.43	0.116
5. Reflective practice	3.58	0.77	59	3.99	0.68	81	-4.92	0.000
26. Professional renewal	3.58	0.83	54	3.92	0.67	77	-3.97	0.000

* =percentage of agreed and strongly agreed responses

The results suggested that these preservice teachers' science education coursework contributed to their belief that they could achieve teaching standards for science education. However, percentages towards optimum results appeared far more pertinent for items 1, 3, 15, 18, 20, and 21 with over 90% believing they could achieve these standards. These items were focused on designing or implementing engaging science learning experiences, and creating and maintaining safe, supportive learning environments. Yet, more than 25% did not agree or strongly agree with items 11, 12, 14, and 24, which included reporting, assessing, valuing diversity and working in professional teams. Practices associated with these items will require further development throughout their degree. The four-year BEd comprises of 32 units, two of which involved science education, yet there are other units that focus on assessment and reporting; hence as second-year preservice teachers their perceptions of assessment and reporting may change towards the end of their degree. This was the preservice teachers' perceptions of their development at the end of their first semester in their second year.

Conclusion

This study investigated preservice teachers' perceptions of their development aligned with state-advocated teaching standards. Pretest-posttest analysis signalled statistical significance for all paired items. These results can assist educators to understand a level of confidence for achieving standards and may also aid in aligning advocated standards within university coursework. That is, items where percentages are closer to 100 in a posttest may indicate closer association with a particular coursework unit; hence aims of a unit may be re-written to reflect this contribution towards achieving a specific standard.

Even though Australia had tried to implement a national curriculum in the 1990's, these documents were generally left on the school shelves as little or no professional development aided its implementation (Marsh, 1994). Nevertheless, and nearly two decades later, Australia will attempt another national curriculum. The government and educational bodies will need to follow through with professional development for teachers if they require teachers to implement these documents at advocated standards. In addition, standards for teaching need to be closely linked to these documents. Furthermore, the success of a new curriculum will rely on universities, as teacher education providers, to align themselves with advocated practices. However, how will key stakeholders know teaching standards are being achieved?

Understanding preservice teachers' perceptions of their ability to implement these standards may be a step towards the process; nevertheless more rigorous measurements will need to be developed. University coursework and related assessments can provide an indication of achieving these standards, especially stringent monitoring of field experiences where preservice teachers are placed in real-world roles to demonstrate their capacities for achieving teaching standards. Indeed, observations of authentic teaching practices will assist in gathering evidence to ascertain a standard achievement, though standards such as working in professional teams, fostering positive parent and community relationships, and professional renewal will be long-term processes that may not be achievable at the completion of a four-year degree because of the nature of these standards.

Researchers and educators must commence investigating the development of reliable instruments and measures that can adequately determine the achievement of teaching standards. Preservice teachers and teachers must be supported before, during and after the process. It is also important that curriculum designers and designers of teaching standards ensure standards are theoretically and empirically supported. Further research is required to address these questions: How do we know these are the optimum standards for teachers? How do they compare with other states and countries? What standards are achievable at the preservice teacher level and which ones are longer-term goals? Indeed, on what grounds will teaching standards be formed and how will they change with growing knowledge about educative processes?

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Appendix 1

Development Towards Teaching Standards

Please respond to the questions below. To preserve anonymity, write your mother's maiden name only.

Mother's maiden name: ________________________________
a) What is your gender? Male Female
b) What is your age? <22 yrs 22 - 29 yrs 30 - 39 yrs >40 yrs

Key: SD = Strongly Disagree D = Disagree U = Uncertain A = Agree SA = Strongly Agree

At this stage of my development as a teacher, I believe I can:

1. Design engaging science learning experiences for individuals.	SD D U A SA
2. Foster positive relationships with families and the community about science.	SD D U A SA
3. Implement engaging science learning experiences for individuals.	SD D U A SA
4. Design science learning experiences that develop numeracy.	SD D U A SA
5. Commit to reflective practice in science education.	SD D U A SA
6. Implement science learning experiences that develop language and literacy.	SD D U A SA
7. Design intellectually challenging science learning experiences.	SD D U A SA
8. Support students' participation in society.	SD D U A SA
9. Implement intellectually challenging science learning experiences.	SD D U A SA
10. Design science learning experiences that value diversity.	SD D U A SA
11. Implement science learning experiences that value diversity.	SD D U A SA
12. Assess constructively on students' learning in science.	SD D U A SA
13. Design flexible science learning experiences for individuals.	SD D U A SA
14. Report constructively on students' learning in science.	SD D U A SA
15. Implement engaging science learning experiences for groups.	SD D U A SA
16. Support students' personal development in science.	SD D U A SA
17. Design science learning experiences that develop language and literacy.	SD D U A SA
18. Create safe and supportive science learning environments.	SD D U A SA
19. Implement flexible science learning experiences for individuals.	SD D U A SA
20. Design engaging science learning experiences for groups.	SD D U A SA
21. Maintain safe and supportive science learning environments.	SD D U A SA
22. Implement science learning experiences that develop numeracy.	SD D U A SA
23. Design flexible science learning experiences for groups.	SD D U A SA
24. Contribute effectively to professional teams in science education.	SD D U A SA
25. Implement flexible science learning experiences for groups.	SD D U A SA
26. Commit to ongoing professional renewal in science education.	SD D U A SA