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Implementing science curriculum change: One primary teacher's perspective

The first National Curriculum for Australia has been introduced to address recurring low scores in literacy, maths and science. Recently, Queensland teachers were expected to implement much of the new Australian Curriculum for the first time. While there have been forums and discussion groups providing feedback to the curriculum committees over the past few years, there has been very little time set aside for teachers and schools to develop a solid understanding of the breadth, the scope and the year level details of the new curriculum prior to implementation. This article examines the support, preparation and practices of one primary school teacher to implement the new science curriculum. This teacher is one of several case studies from a larger project. The use of a survey, observations and interviews reveal the practices of a primary teacher who wanted to give the new science curriculum a genuine chance, and the overall context in which she did so.

Introduction

The Australian Curriculum, Assessment and Reporting Authority (ACARA) administered the national curriculum reform movement across Australia. Its conception and development was guided by the Melbourne Declaration on Educational Goals for Young Australians (Kato & Hearfield, 2008). This declaration intends to prepare students for the 21st Century by encouraging development in: knowledge, skills and understanding of learning areas, general capabilities and cross-curriculum priorities. Stakeholders from various societal positions contributed to the development of the National Curriculum through comments and suggestions. Support for teacher implementation was left primarily to the schools. Minimal support was made available by Education Queensland in the form of professional development and subject preparation. Since the ACARA curriculum content information is written in broad terms, Education Queensland (EQ), now Department of Education, Training and Employment (DETE), decided to assist teachers by creating another set of documents through Queensland Studies Authority (QSA) called Curriculum into Classroom (C2C). The C2C materials are the specific subject content, assessment

tasks, teaching strategies, resources, and lesson plans designed to provide specific help for teachers.

According to van Driel, Beijaard & Verloop (2001) and Garii (2006), this top-down approach to curriculum support often results in failed reform. Several studies and authors (Fullan, 1991 & 2001; Carless, 1998; Powell & Anderson, 2002) indicate that systemic curriculum change is most successful with high quality teaching support and training materials to assist teachers in addressing/shaping their attitudes, knowledge and practices. The implementation of reform-based science curriculum often requires teachers to make adjustments in their understanding of subject matter and the learning and teaching of science. Without support, teachers are inclined to become frustrated and return to previous methods of teaching.

In Queensland, implementation of the new national curriculum began in 2011 with full implementation by 2013. Education Queensland stated that all schools were to begin implementation of English, Maths, Science and History in 2012, with each school choosing its own speed and method of implementation to best suit their school communities. The roll out, support and delivery was the responsibility of schools and teachers.

The Problem

The Australian Curriculum and a set of resources referred to as Curriculum into Classroom (C2C) was delivered by Education Queensland/DETE to Queensland state school teachers with detailed lesson plans for each subject area and a myriad of possible digital resources. The goal was to achieve state schooling that has "one vision, one curriculum, one platform, different ways" (DETE 2013). It was expected that teachers would be able to pick up the resources and teach science thoroughly and competently. However, according to previous curriculum reform movements (Roehig & Kruse, 2005) the science curriculum changes will require teachers to acquire new subject matter knowledge and develop inquiry-teaching strategies in order to implement the new science curriculum effectively. In addition, studies over the last few decades have indicated that primary teachers lack the knowledge and confidence to teach science. Many teachers even avoid science when possible (Goodrum,

Hackling & Rennie, 2001; Appleton, 2003, 2007). While there has been some attempt in the past to address these concerns, the outcome has not been satisfactory (Goodrum et al. 1992; Masters, 2009). Therefore, the research focus for this study was to identify the challenges and successes of a participating state school teacher when implementing the new science curriculum for the first time.

Background and Literature Review

Internationally, many countries considering the way science is taught have found it is often delivered through traditional means: lecture, rote memorizing of content, and theories (Appleton, 1992; Palmer, 2001; Watters & Ginn, 1995). This method of delivery has become increasingly criticized (van Driel, et al., 2001), generating a desire for curriculum reform. The Australian Curriculum, Assessment and Reporting Authority (ACARA) was created to lead the creation and development of the recent national curriculum reform in Australia. The development followed specific processes that included the use of advisory groups, writing groups and panels. Many of the workers were volunteers from many societal sectors. The head writer, Denis Goodrum, is well known internationally for his research in science education and curriculum.

Once the ACARA writers completed a draft, stakeholders were invited to send comments to the developers. Stakeholders raised several concerns which were considered by the developers (ACARA, 2012), but the main point not addressed was the ability and/or willingness of primary teachers to implement the new science curriculum. While "Science Sparks" (specialist science teachers, mostly high school teachers, chosen to assist colleagues in the primary school) were made available to schools who volunteered to use their services, the sessions to schools and teachers were inconsistent. No other professional development for science was prepared by Education Queensland or DETE to assist with the implementation process. Instead schools were told they could deliver the new curriculum in a manner they saw fit for their school communities. Nevertheless, many factors such as budgets, roll out time frame, the number of new curriculum areas to implement and professional

development for teachers could be expected to impact on the success and outcomes of implementation.

The new Australian science curriculum contains four main content areas: biological science, chemical science, earth and space science and physical science. In addition, two components called human endeavour and inquiry skills help to round off the total science approach and philosophy (ACARA). The C2C materials provide teachers with a comprehensive set of materials that outline possible resources, teaching strategies, lessons plans, assessment and more. While this is meant to aid in the unifying of teaching across schools, anecdotal evidence suggests that many of the documents are not particularly helpful. Additionally, the limited professional development provided by schools would not be particularly helpful for long-term effect (Roehrig & Kruse, 2005).

Curriculum change is a regular occurrence in schools that may meet resistance by school personnel. Tobin and Dawson (1992) believe that if teachers, students and the school culture are considered, reform will be more successful. It is well understood that teachers are in the driver's seat in regards to classroom teaching. Several studies have shown that teacher beliefs, attitudes and knowledge are important and should be considered during reform movements (Cheng 1994, Tobin & McRobbie, 1996; Duffee & Aikenhead, 1992; Appleton, 2003, 2006; Mulholland & Wallace, 2001, 2005; Roehrig & Kruse, 2005). All aspects of understanding the new curriculum, including theoretical frameworks, content knowledge, planning, teaching, and assessing need to be carefully and thoughtfully addressed through professional development with the teachers who are in charge of implementing the new curriculum. In a study considering reform-based science curriculum in high school, Roehrig & Kruse (2005) identified that even teachers with positive beliefs towards the reform-based teaching, had shortcomings in content knowledge and the teaching of science lessons. They concluded that teachers will implement reform-based curriculum according to their own beliefs, attitudes and knowledge unless there is training that will provide guidance and clarity towards the new expectations and curriculum demands.

The implementation of the new curriculum may also be affected by school organizational factors (Cheng, 1991, 1994) in that school organisations often choose

how they will maximise the curriculum change. According to Cheng (1994), there are three kinds of approaches to curriculum change. The first is *Simplistic curriculum change. "*This Approach assumes teachers are passive, their competence is static and curriculum change can be planned and implemented effectively by administrators or external experts" (p. 27). The second is *Teacher competence development*. This approach assumes curriculum change is imposed and teacher competence can be developed easily to satisfy all needs of the changed curriculum. The third approach identifies both the curriculum and the teachers as needing change to maximise the effectiveness of the curriculum and to facilitate teaching and learning. This is called *Dynamic curriculum change*. Cheng's studies have found the first two approaches to be short term and mechanical changes. However, the third approach incorporates teacher voice and ideas with the curriculum change. The Australian National Curriculum and C2C development fits within the *teacher competence development* approach, so implementation difficulties could be expected.

Methodology

The case study reported here is one selected from a number of cases in a larger study. To investigate the research focus, it was necessary to gather data directly from the teacher and her teaching actions using surveys, interviews and field notes. A broader data set about the school context was obtained through surveys completed by each teacher in the school, and interviews with the school administrators (these data are reported here only where they illuminate aspects of the case description).

Participant Selection

The participant teacher was a full time year 5 teacher from a state school, called "Kim". She was chosen because she was located at a school geographically close to the researcher, and is typical of a large number of teachers who are currently teaching in Queensland schools. She has over 20 years of experience, and has had little to no science training in high school and university. Kim loves teaching and involves herself in many of the school functions and committees. She wanted to give the new science curriculum an honest try by following it as completely as she could without utilizing the curriculum documents and resources associated with the previous State-issued science curriculum.

Data Analysis

The surveys were analysed through SPSS. The interviews were transcribed and main themes/points cross-referenced with the surveys and/or field notes.

Case Data

This section will consider data from the three sources mentioned earlier; interviews, observations and surveys.

Kim is from a state school of 250 students from Prep to year 7 near a provincial city centre. This school has a large transient population with about 7% who speak English as a second language. Many of the families live in nearby apartments. There are 10 full time teachers with 30% male and 70% female. Kim's class consisted of 27 students with four special needs students and a couple of English as second language students. There was an aide who helped in her room for an hour 3-4 times a week.

Kim's school was introduced to the new Australian Curriculum through staff meetings. The principal also arranged for a former high school science teacher to work with teachers to help develop content knowledge and science inquiry skills. Teacher participation in this was on a voluntary basis but was highly encouraged. The teacher surveys revealed that many teachers felt there was a limited amount of time put into the planning stage for implementation of the curriculum, with 40% reporting little or no school or district planning.

The amount of professional development obtained by the teachers varied: 40% reporting little or no professional development, and 60% some. Regarding resources, 80% felt they had some resources necessary for teaching science. Many indicated a need for more resources that align with the new curriculum topics and activities.

Kim's preparation

Before the teaching term, Kim revealed her planning processes and concerns for science teaching. To her, being handed a new curriculum to sort out was a familiar event that often brings mixed feelings and extra stress:

"No sooner do I get the one curriculum down pat and I have to start all over again with a new one."

Kim was willing to give the new curriculum a chance and put away all other resources as she was informed she needed to do. She briefly consulted the ACARA online site but spent most of her time using the *Queensland Studies Authority* (QSA) site, the *MY School* site, and the *Curriculum to Classroom* (C2C) materials provided for teachers. Since the C2C materials were prepared to supposedly line up with the National Curriculum, Kim did not check alignment of the content or skills.
The following case description is organised around several headings that emerged from the data.

The C2C curriculum was over-whelming.
At first, Kim followed the lessons in C2C as closely as she could. Her first topic/unit was Matter (solids, liquids and gases). She found it quickly became overwhelming: there was simply too much information and too many activities to cover. She was aware the writers of C2C deliberately inserted a lot of source material and activity ideas in the expectation that teachers would select from the smorgasbord provided:
"When it came out, you just looked it and went HUGE, HUGE. And you didn't realise the depth of it….it got bigger and bigger. We were told there was a new curriculum coming out and we all had to follow it. I just knew there was no way in the world I could teach all of that. I'd do what I can and took what I thought would work on board." When beginning to plan, Kim sought the aims and objectives of the unit. She knew she needed to reduce the amount of activities and lessons due to the interruptions common in schools.
"I don't think there is anyone who could teach everything that is in the C2C." "Not with all the interruptions like swimming lessons going on in schools."

The C2C curriculum was based on some assumptions about delivery.
Kim believed this new curriculum was very structured and not flexible for schools. It did not cater for interruptions and changes to the daily schedule. It seemed to her that there had been an assumption by the C2C writers that teachers will teach science for set times and days each week. As she used the new science curriculum, she discovered the lessons needed to be adjusted to meet the needs of her class.
"Some of it [science curriculum] is fine [suitable] and some of it I think, why are we teaching that? Because it's just wow…. hard. I know they want that taught but I'll teach it at the level I know the children can work at. So I've adapted it. Kim thought

common sense was needed to adapt the resources to meet students' needs and time constraints.

Implementing the C2C curriculum required time, IT skills, and access.

One of Kim's concerns was the vast amount of resources that took an unrealistic amount of time to sort through. In time Kim began to design the lessons for her students with minimal guidance from the C2C materials. Sometimes she used activities she has used in the past.

"I think there is so much of it out there that it gets a bit, Oh my god. You know."

"And there are so many [Internet] links. There is this link and that link. You end up getting lost." When she wanted to go to a previous activity, she often had difficulty finding it.

Kim used to be able to work from home, but not with C2C. Now she has trouble accessing the C2C materials with poor Internet reception and risks of the computer shutting down.

"I think it is really unfair that the department wants us to access everything online and we don't get any support for that at all."

She repeatedly claimed preparing lessons is time consuming.

"[Preparation] It's got to be in your own time." There are regular meetings, duties and daily issues that are handled after school and during non-contact time.

Kim also found gathering the science materials difficult. She would like a budget to purchase consumable materials.

When asked about the support structure in the school, she admitted there is a curriculum committee she can go to if needed.

"I have no particular expectations of admin [to help us]. If I have questions I go and ask. If they can't help, they look into it for you. I don't have high expectations." She believes that everyone is extra busy in a small school.

Primary teachers do not get the time to fully comprehend the substance of the new curriculum at a deep level. There is not time to sort through the myriad of materials

to determine its value and usefulness for their particular students within a week, not to mention for each subject they teach.

Unfamiliar science content was a challenge for the teacher.

Kim found that some of the science concepts in the new curriculum she has never taught and some she knows very little about. She has no particular science background. Kim described her best science lesson with the old curriculum to have occurred last year with the science spark teacher who helped her, and the students make solar powered windmills and filters. "This year a moon crater activity from C2C was not very good…it didn't work well. We didn't quite understand it. The best were the three states of matter from C2C."

The C2C curriculum had some limitations and failings as well as benefits.

Kim found the new curriculum objectives for the units useful. This kept her focused on her learning outcomes. The activities were the most difficult for her. Photocopying, the computer access, the level of the work and sometimes the clarification of the activities were a concern. It seems with each positive Kim would mention there would also be a negative.

"I think good science learning also includes what worked, what didn't work and then play with it."

"Abstract questions in C2C were too hard. They still need concrete activities. C2C needs more concrete activities."

"I don't use all the worksheets [photocopying]; I bring them up on the white board. Some are a waste of space on paper."

Kim found she had to adapt the provided assessment to meet the needs of her students and her beliefs about assessment expectations.

"Assessment in C2C is a bit waffly…. not always appropriate."

"C2C expects a lot of observation and note taking. It didn't allow for clarification of deeper levels of learning."

In spite of all the challenges, Kim still identified the positives.

"Some of C2C is really good. Some of their ideas….some science experiments. "

Interpretation and conclusions

The new science curriculum has attempted to reduce diversity of the science topics and concepts studied between schools and states. A central bank of lessons and materials has been provided to Queensland schools. The teacher in this case study endeavoured to give the new C2C version of the curriculum a chance and tried to follow it completely. When she found it overwhelming, she reverted to her years of experience as a teacher to guide her through the lesson planning and teaching. As Tobin and Dawson (1992), Cheng (1994) and Roehrig, Kruse, & Kern (2007) identified, teacher beliefs, attitudes and knowledge are important when they begin to implement new curriculum. Teachers will be inclined to return to their beliefs and habits when they are not fully trained to understand and/or implement new curriculum. This will hinder progress toward the new goals and aims of the developers. While this paper reports on the views and experiences of one teacher in Queensland, it could be assumed that there are other teachers who are experiencing similar results. If this is true, then one could also assume there will be many variations to the C2C lessons executed between teachers and across schools. This in turn could result in the level of knowledge of teaching and learning and the strategies used for teaching and learning remaining where they have been.

Education systems, schools and teachers go through never ending cycles of new curriculum reform. Government bodies and educational leaders will continue to find concerns with the progress of student learning and/or the teaching in the classrooms. Therefore, curriculum reform seems to be an inevitable method of choice to supposedly solve all our educational woes. If this is to continue to be the practice, then educational systems and school leaders need to find more time to incorporate teacher input and a more systematic way of training teachers to use the new curriculum.

Future

This case study will be combined with other case studies involving teachers from a state school, an independent school and a catholic school. Comparisons will be made between teachers and schools to determine commonalities as well as productive practices that improve teaching and learning.

Further studies need to be completed to determine if supportive and effective teacher professional development rather than curriculum reform would be the better option when trying to improve teaching and learning in schools.

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