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Recommendations for a Professional Development Framework

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Recommendations for a Professional Development Framework

An Interactive Qualifying Project Report
Submitted to the faculty of
Worcester Polytechnic Institute
In partial fulfilment of the requirements
For the degree of Bachelor of Science by:

Michael D'Onofrio
Helen Hanson
Kevin Kardian
Henry Sockbeson

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An Interactive Qualifying Project Report
Submitted to the Australian Bureau of Statistics
And the Faculty of the
Worcester Polytechnic Institute
by

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Date: May 4, 2005

Approval

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Abstract:

Our project group, in association with the Australian Bureau of Statistics (ABS), designed a professional development framework tailored toward teaching statistics to middle years mathematics teachers. We held focus groups with mathematics teachers and interviews with administrative authorities and professional development experts to develop recommendations for content, delivery, and distribution, with the purpose of creating an effective and appealing program. In this way, we hoped to assist the ABS in promoting a more statistically aware and literate Australian population.

Acknowledgements

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Executive Summary

The ability to critically evaluate and apply statistical information can be a valuable skill in gaining a better understanding of society as a whole and can aid in the development of informed opinions. Furthermore, many professions rely on the utilisation and interpretation of compiled data. As a result, the ability to use statistics is a valuable skill for planning and evaluating both personal and professional decisions.

The Australian Bureau of Statistics (ABS), the organisation responsible for the collection and distribution of statistics throughout Australia, maintains that the ability of the general populace to make informed decisions is closely related to their level of statistical literacy. ABS has noted that the number of statisticians graduating from Australian universities is declining, suggesting an insufficient level of interest in statistics. In an effort to improve overall interest in statistics, the Bureau has chosen to focus on expanding statistical literacy among students in the middle years (8-10) of their education.

While the Australian curriculum contains statistical content, the training that mathematics teachers receive in statistics is less comprehensive than the training that they receive in other subject areas. As a result, many mathematics teachers tend to favour other areas of mathematics over statistics in the classroom. The ABS is of the opinion that improving teachers' interest in statistics will result in an increase in students' enthusiasm. Recognising that professional development programs have the capacity to influence how teachers educate students, the Australian Bureau of Statistics has chosen to create a professional development program for mathematics teachers, the goal of which is to expand upon these teachers' statistical literacy and help them incorporate statistics skills in the classroom.

The Bureau has not previously created a professional development program in the field of mathematics education. Thus, they have sponsored this project to develop an initial approach for the creation of a professional development program. The goal of this project was to design a professional development framework that includes recommendations for content, delivery mechanisms, and distribution paths, with the purpose of creating an effective and appealing program tailored towards teaching statistics to middle years mathematics teachers throughout Australia.

As the program will target teachers in the field of mathematics, we aimed to discover mathematics educators' opinions on effective professional development. Additionally, we examined professional development program content and delivery mechanisms. Finally, we researched and assessed the various paths that a program can follow from the Australian Bureau of Statistics to the mathematics teachers. Throughout our research, we identified the initial development costs of a program along with the recurring delivery expenses in order to later weigh them against their potential benefits. When all of the data were collected, we considered the advantages and limitations of the various options for the creation of a professional development framework and analysed how to combine these elements to create an effective program.

Our analysis indicated that there are several significant components that contribute to the content of an effective professional development program. **We recommend that all professional development programs created by the NESU include a combination of effective classroom practices, middle years statistical theory, and practical applications of that theory.**

To the end of successfully circulating the program to a very large target audience, **we recommend that any program developed by the ABS adopt a combination of distribution through the Departments of Education and the Mathematics Teachers Associations.** While our findings indicated that the Departments of Education are capable of providing access to teachers in all areas of the country, publicising through the Teachers Associations will provide an additional motivation for many of the teachers to participate.

Our findings indicated that some teachers have attempted to access the ABS website for information to use in the classroom, but have been unable to find this information. Furthermore, experts believe that teachers should develop their own classroom materials to facilitate integration into their own classrooms. To this end, **we recommend that the Australian Bureau of Statistics work to improve the usability of the resources already available to teachers on their website, and to expand those resources.** The first step should be to make the website easier to navigate. The second step should be the creation of an online tutorial for the development of lesson plans based on ABS resources.

Collaboration and networking between participants during a professional development program was highly favoured in our findings. Experts stated that if a network between teachers could be established, they would be able to use each other for support to clarify points of confusion or develop classroom materials. **We recommend that a discussion forum be implemented on the ABS website, and that participants in any professional development program be introduced to and trained in the use of this technology for their own benefit.**

Our analysis has shown that a face-to-face professional development program, while potentially the most effective type of course, may not be feasible for the NESU to implement immediately. As a result, we have concluded that an alternative program could be developed using another delivery mechanism that, while potentially less effective, would still result in some improvement among its participants. **If the resources for a face-to-face program are not available, we recommend that the ABS create an electronic professional development program for independent study to be distributed through a compact disk.** We also recommend that such a program contain a handbook that outlines solutions to common technological problems that the user may encounter. We suggest that a professional development program delivered through compact disks be divided into several modules, organised by topic, and contain a menu from which the participants can select what modules they wish to take based on their current knowledge level.

If it is within the resources of the National Education Service Unit (NESU), we recommend that the Australian Bureau of Statistics design a face-to-face professional development course. This course should range between three and five sessions, depending on the amount of content that is presented, with one to two weeks between each session. We also recommend that the first session last between three and five hours and subsequent sessions last between one and two hours. We discourage the ABS from creating a one-day face-to-face professional development program. If a face-to-face program over multiple days proves cost-prohibitive, the NESU should choose to implement the independent study program. Furthermore, in order to extend the reach of a face-to-face program, we recommend that any face-to-face course present the option for distance learning participation after the first session. Classes should contain between thirty and fifty participants. The first session of a face-to-face professional development program should include the following elements: an overview of the goals of the program, a summary of middle years statistical theory, and an interactive activity. We also recommend that subsequent sessions of the course begin with time for feedback from the participants. Finally, the last session of a face-to-face professional development program should include an overview of the ABS resources available to participants after the class.

We recommend that the NESU first pilot a face-to-face program in the Australian Capitol Territory (ACT) and deliver this program in conjunction with the ACT Department of Education. If the NESU chooses to then develop a face-to-face course on a national scale, we recommend that the ABS choose between one of the two following options: collaboration with the state Departments of Education, or liaising with branches of the ABS outside of Victoria. Through collaboration, the recurring costs incurred upon the NESU will be reduced.

1 Introduction

The ability to critically evaluate and apply statistical information can be a valuable skill in gaining a better understanding of society as a whole and can aid in the development of informed opinions. Furthermore, many professions rely on the utilisation and interpretation of compiled data. As a result, the ability to use statistics is a valuable skill for planning and evaluating both personal and professional decisions.

The Australian Bureau of Statistics (ABS), the organisation responsible for the collection and distribution of statistics throughout Australia, maintains that the ability of the general populace to make informed decisions is closely related to their level of statistical literacy. ABS has noted that the number of statisticians graduating from Australian universities is declining, suggesting an insufficient level of interest in statistics. In an effort to improve overall interest in statistics, the Bureau has chosen to focus on expanding statistical literacy among students in the middle years (8-10) of their education.

While the Australian curriculum contains statistical content, the training that mathematics teachers receive in statistics is less comprehensive than the training that they receive in other subject areas. As a result, many mathematics teachers tend to favour other areas of mathematics over statistics in the classroom. The ABS is of the opinion that improving teachers' interest in statistics will result in an increase in students' enthusiasm. Recognising that professional development programs have the capacity to influence how teachers educate students, the Australian Bureau of Statistics has chosen to create a professional development program for mathematics teachers, the goal of which is to expand upon these teachers' statistical literacy and help them incorporate statistics skills in the classroom.

The Bureau has not previously created a professional development program in the field of mathematics education. Thus, they have sponsored this project to develop an initial approach for the creation of a professional development program. The goal of this project was to design a professional development framework that includes recommendations for content, delivery mechanisms, and distribution paths, with the purpose of creating an effective and appealing program tailored towards teaching statistics to middle years mathematics teachers throughout Australia. To collect the data that was the basis of our recommendations, we spoke to practicing teachers, school administrators, and experts who have created professional development programs. Using the information gathered, we developed recommendations to the Australian Bureau of Statistics regarding effective techniques and practices involved in professional development for statistics. In this way, we hoped to assist the Australian Bureau of Statistics to create a more statistically aware and literate Australian population.

2 Background

This chapter presents background information relevant to our project. It begins with a section on statistical literacy, introduced by an explanation of mathematical literacy because there is generally seen to be a connection between the two, and its relevance to society. That component is followed by an explanation of the Australian Bureau of Statistics, to complete the basis of the rationale on which our project has been created. Next, we present a section on professional development, which includes a definition and purpose. This section also includes information on education techniques and professional development frameworks. Finally, a synopsis of the education systems in the United States and Australia, containing information on the mathematics curriculum and professional development standards for educators in these nations, is given. This information is to provide a background on the Australian education system and to allow similarities with the American structure to be seen.

2.1 Mathematical Literacy

Gouthro (2004) claims that as the realm of mathematics continues to expand, it is becoming increasingly difficult to find any profession that does not require some degree of competency in the area of mathematics. Thus, she argues, the concept of *mathematical literacy* is becoming increasingly significant. The definition of mathematical literacy comprises of two separate but equally important components. According to the Programme for International Student Assessment (PISA/OECD) (1982), mathematical literacy consists of a full understanding of the technical aspects of the field as well as the ability to apply these principles in industry or society. Cockcroft (1982) explains that the ability to critically assess data in the context of its technical analysis defines the most fundamental difference between skill in mathematics and mathematical literacy. Mathematical literacy, therefore, can be defined as an understanding of mathematical principles and methods combined with the ability to apply those methods in society. Cockcroft's focus on data also highlights the central importance of statistical literacy in the need for increased mathematical literacy.

2.1.1 Statistical Literacy

The Australian Bureau of Statistics (2004) defines statistical literacy as "people's ability to understand, interpret, and evaluate statistical information and data related arguments that they may encounter in diverse contexts and their ability to effectively communicate conclusions to a non-statistical audience." Chance (2000) states that being statistically literate enables a person to make informed decisions with regards to statistical knowledge, while Giesbrecht (1996) claims that statistical literacy entails a level of competency that enables one to critique others' arguments at a statistical level, using mathematical knowledge to refute ungrounded arguments related to social issues and logically form one's own opinion. Similarly, Rumsey (2002) asserts that statistical literacy is strongly connected to a concern for various social issues. She implies that

being statistically literate requires the ability to use statistics to improve one's understanding of these issues, thus improving the quality of one's judgments. A conclusion is that a statistically literate person is capable of contributing his or her knowledge to society as a whole.

According to Giesbrecht (1996), statistical literacy is increasingly necessary in a modern society. He claims that statistics are more involved in daily life than any other form of mathematics. This claim is supported by OECD/PISA (2003), which asserts that new applications of statistics cover a range of experiences, both inside and outside of the workplace. It emphasises that "within most media outlets there are numerous statistical facts on weather, economics, medicine and sports" (OECD/PISA 2003). Both Giesbrecht (1996) and OECD (2003) state that, as information becomes increasingly available through technological innovation, people are experiencing new applications of statistics. Giesbrecht (1996) asserts that, as the ability to collect and manipulate data through technology improves, statements of an all-encompassing nature can be more easily refuted. He claims that as a result these kinds of generalisations, once prevalent in politics and media, are becoming less frequent, and that an issue can no longer remain black and white when there is a wealth of knowledge and information present to assess all of the grey area in between. It appears that statistical literacy is the key to unlocking knowledge and analysing it for a greater understanding of a problem. Therefore, it follows that the ability to make informed decisions using knowledge of statistics is highly important.

2.1.2 Australian Bureau of Statistics' Stance on Statistical Literacy

The Australian Bureau of Statistics (ABS) is Australia's official statistical organisation (ABS 2005). The official mission statement of the ABS and description of its structure is given in Appendix A. Trewin, Fisher, and Wilson (2003) state that statistical literacy, composed of statistical understanding and statistical capability, is increasing in significance to Australian society. Despite its importance, a study conducted by Baddeley (2005) has shown that Australian university students' interest in statistics is declining. Fifteen years ago, there were ten statistics departments in universities around Australia; presently only two are still operating (Canberra Times 2004). Moreover, the Australian workforce has an unmet need for statisticians (Trewin et al A 2003; Canberra Times 2004). Some of the major employers of statisticians in Australia are the universities, Federal and State/Territory Departments, ABS, Australian Commonwealth Science and Industry Research Organisation (CSIRO), pharmaceutical companies, and the financial sector (Trewin et al A 2003). As a government agency that employs a large number of statisticians and promotes statistical literacy, the ABS has a clear incentive to reverse the situation (Trewin et al A 2003).

The National Education Services Unit (NESU) the a section of the ABS whose role is to foster the development of statistical literacy among the students and teachers in the Australian education system and assist in increasing the number of statisticians nationwide. It is the preferred position of the ABS that statistics be taught as a core discipline separate from mathematics (ABS ACT 2004). To reach this goal, the ABS, in

collaboration with the Statistical Society of Australia and the Curriculum Corporation, developed the Australian Statistics Education System (ASES) (Trewin et al B 2003). In addition to working towards a statistics syllabus, the NESU focuses on increasing the statistical exposure of teachers and students (ABS SACE 2004). The rationale behind this approach is that students could become more interested in statistics as a result, which in turn should cause the Australian population's statistical literacy to increase.

2.2 Professional Development

Professional development is defined by the Commission on Applied and Clinical Sociology as the "process of learning and keeping up-to-date in one's area of expertise" (Commission 2005). Professions of differing skill sets tend to provide more or less explicit definitions of professional development, but the general concept is consistent. Professional development is the method used by professionals to stay abreast on the skills and knowledge required by their occupations.

An effective professional development program is capable of providing many benefits to a modern workplace. According to Bottomley (1999), professional development allows for a higher-trained and more flexible work force. Garrick (1999) asserts that the social and economic condition of a country is dependent upon the corresponding conditions of the people within it. He states that a highly trained and well-educated population improves the state of the nation as a whole. The prevalent theory appears to be that professional development is important for occupational success on a personal, organisational, and national level.

The concept that professional development is significant to a population is reflected in the positions of national associations. Two examples supporting this statement are the political platform of an Australian party and the official position of an education society in the United States. In 1994 the Australian Labour Party political stance on professional development was that professionals who have current skills in their field allow for an improvement in the productivity and resources of the country. The Party held that professional development had to be constantly updated so that it remained geared towards the "current needs of the labour market and to future employment opportunities" (Bottomley 1999). The National Education Association (NEA) (2005) fully supports professional development for education staff because education is constantly evolving. According to the NEA, professional development programs can assist new teachers learn important skills as well as aid more experienced teachers in rejuvenating interest in their fields. Both organisations conclude that as new techniques and skill sets are implemented, professional development needs to stay current.

Professional development programs appear to be an important component in the field of education. Professional development courses for educators are required by the national government in both Australia and the United States (DoE AU 2005, DoE USA 2004). As previously mentioned, teaching techniques evolve as new educational theories emerge. According to Iwanicki (1981), education and students' needs are also changing, and it is

necessary for teachers' knowledge to change with them. It is generally accepted that professional development programs can improve teaching ability for the benefit of the students.

2.2.1 Flexible Learning

One emerging education technique for professional development is known as *flexible learning*. Garrick (1999) defines flexible learning as adaptable learning that takes place outside of the traditional classroom. This technique is being applied at universities across the world with emphasis on continuing education and professional development programs (Bottomley 1999). According to Hay (1999) there is an important relationship between knowledge, learning, and work that flexible learning utilises to foster education. Because of its ability to be adapted to real-world examples and practical experience, this method is becoming more prevalent for educating adults.

Examples of flexible learning can be found in existing professional development settings, including external studies, correspondence education, extramural classrooms, extension studies, and off-campus studies (Evans 1999). These types of programs take place outside the traditional classroom and can incorporate a variety of teaching styles from traditional lecturing to group collaboration. Some flexible learning formats are cooperative learning and Internet-based courses. Examples of the types of delivery mechanisms that these programs can employ are email, chat rooms, discussion forums, telephone conversations, face-to-face meetings, facsimile, and audio-video conferences (Cavanaugh 2002). Flexible learning also incorporates the ideas of open classrooms, discovery learning, and integrated studies (Evans 1999).

Examples of three universities that are incorporating flexible learning techniques into their education philosophies are Wake Forest University (United States), the University of British Columbia (Canada), and Deakin University (Australia). At Wake Forest, the administration is changing the focus of the university's education philosophy, making information and technology the centre of their teaching and learning process. The goal of this new focus is to integrate a new teaching style to the existing education methods while the image of the student body remains constant. Currently, Wake Forest is a medium-sized elite liberal arts university. By adapting a more flexible approach to learning, the administration hopes to improve Wake Forest's national ranking as a university. This new strategy is being implemented through the standardisation of the technology that the students and staff utilise. All faculty and students are being supplied with the same notebook computers and software. The computers are updated every two years and the software is upgraded annually. Since the majority of the Wake Forest students are on campus, the entire campus was networked and rewired with fibre optics. The rationale behind supplying these resources was to encourage a connection between staff and students and to increase the ease of this connection's implementation. The emphasis is being taken away from the traditional classroom and placed more on different methods of learning. For example, faculty-student meetings are encouraged along with group initiatives. (Bottomley 1999)

At the University of British Columbia (UBC), the teaching style itself is being modified, and the role of the traditional professor is changing to that of an education coach. Students take a more active role, while the participation of the professors is less dominant. The goal of this modification is to allow the students to control their own educational experiences. The new focus is on an increased quality in the students versus a greater efficiency in educating them. Similar to Wake Forest, UBC does not wish to transform its national image but instead to improve upon its reputation. (Bottomley 1999)

Deakin University has made changes to foster continuous learning in its students. In order to accomplish this objective, the university is implementing an increased number of distance-learning courses in an effort to appeal to returning students. In 1998, Deakin had a student population of over 29,000 with 12,600 students studying off-campus. Another 30,000 adults were also enrolled in professional development programs at the university. Deakin has also developed the necessary support networks in its faculty and administrative practices to connect the distance campus (Bottomley 1999). While some obstacles to these methods have been encountered (Bottomley 1999), they have been shown to be helpful in a professional development setting, and experts (Garrick & Jakupec 1999; Evans 1999) claim that flexible learning can allow for a more successful approach to adult education.

Cavanaugh (2002) explains that in distance-learning settings it is still important to promote a comfortable and controlled learning environment, similar to that of a traditional classroom. In this situation, the teacher needs to motivate the students to stimulate learning. One example of a distance-learning program is a semester long professional development course for middle school mathematics teachers on algebra being conducted at Worcester Polytechnic Institute (USA). There were approximately sixty students in this course during the Spring, 2005 session. Twenty students were present in the classroom while another forty participated in the class from a distant location. The program incorporated different technologies, such as the Internet and television, to allow the distant students to participate. The class was organised like a basic lecture course with each class covering the previous week's homework and then introducing new material. The students in the classroom were able to ask questions in person while the other participants emailed the professor. (Goulet 2005) In this type of setting, the professor utilises the features of a traditional classroom is order to promote a controlled and comfortable environment that is suitable and supportive of learning.

Because of the increased level of technology required to create an effective learning environment, flexible learning programs tend to have more initial expenses than a traditional education setting. Cavanaugh (2002) maintains that while the cost of distance-learning programs is sometimes high, the benefits appear to offset it. According to Cavanaugh (2002), as technology develops, Internet-based classes and education programs are becoming more common, along with other types of distance-learning. Cavanaugh claims these methods are important because they allow for flexibility in more constrained schedules. She elaborates by explaining that adults seeking professional development programs are most likely working full-time; by taking a distance-learning

course, the participant is able to adapt the program to his or her own schedule. As a result, the student is able to commit more time to his or her studies. This theory is supported by the opinions of Hay (1999), Garrick (1999), Bottomley (1999), and Evans (1999). Cavanaugh's opinion is that distance-learning programs, while influenced by the technological limitations of their audiences, are very successful.

2.2.2 Problem-Based Learning

Another effective adult education technique is *problem-based learning*, which is defined by Levin and Pierce (2001) as a method in which students apply their creative thinking skills to specific problems. Dean (2001) elaborates on problem-based learning by stating that the teacher assigns a problem with no concrete answer to a group of students; the problem is not necessarily clear and can be poorly worded intentionally, so as to leave it open to interpretation. The students are then forced to decide what their problem actually entails and what their approach should be. Finally, the group brainstorms, researches, and tries to develop a solution.

Problem-based learning is similar to project-based learning, which incorporates group projects that allow students to reach certain end products in a flexible and self-motivated environment (PLC 2003). The underlying difference between the two techniques is that project-based learning focuses on producing a concrete final product while problem-based learning works towards developing a possible solution. According to Sage (2001), Dean (2001), and Levin and Pierce (2001), problem-based learning can be a rewarding and effective technique when utilised in education.

There is a general consensus that professional development material should be relevant to the participants; any strategies adopted should reflect this theory. Dean (2001) explains how problem-based learning can be used not only to teach theories or methods to students, but also to educate them on real world issues. She uses this technique in the *Issues in Education* course at Samford University not only to teach students various educational techniques but also to make them aware of current concerns in teaching. Levin and Pierce (2001) explain that problem-based learning can be difficult to incorporate into a program initially because it may intimidate both teachers and students, but that it can be successful once implemented. As a result, it appears that this technique can be used effectively to incorporate current events and real world relevance into professional development programs.

2.2.3 Layout and Content of Professional Development Programs

Many studies have been done regarding successful professional development programs, and some model frameworks have been developed as a result. The effective frameworks are based on the assumption that participants are competent professionals working to improve their knowledge in their field of expertise (Garrick & Jakepuc 1999; Cavanaugh 2002; Iwanicki 1981). Cyr (2005) emphasises that, when assembling a professional

development curriculum, it is important to keep the concerns and opinions of teachers in consideration because they are the people for whom the program is designed.

An integral aspect of professional development program is that the skills being covered must be taught in a context that is relevant to its participants. The information covered should be taught at the appropriate level for participant understanding. Cyr (2005) explains that there is a fine line between confusing the teachers and disrespecting them; one must find the proper balance between technical terminology and conversational colloquialism. Sage (2001) states that, when teaching a course, it is essential that the material covered be important to the participants. She explains that if it is not, sometimes the students feel that the instructor is wasting their time. This opinion has also been reflected in other sources (Cyr 2005; Garrick & Jakepuc 1999; Iwanicki 1981, Sage 2001). The conclusion that can be drawn from the opinions of the experts is that an emphasis needs to be placed on the participants and their needs when designing a professional development program.

A model professional development program for educators recommended by Cyr was a ten-day module. During the course, as outlined by Cyr, each day should be scheduled similarly, allowing the teachers to develop a routine. Her opinion is that it is important to teach theory along with application, allowing teachers to perform hands-on activities that apply directly to the subject matter and its related theories. She stats classroom material should be developed in the professional development program. Cyr uses this method because it appears to increase the information and resources gained by the teachers attending the program. Her reasoning is that if classroom materials are created during the professional development course, it is easier for the teachers to incorporate the new ideas into their existing curriculum and they will have a high likelihood of doing so. Also, if all the participants are able to access all the materials developed they will have a broader wealth of resources from which to draw. (Cyr 2005)

Sage describes a professional development program for educators that she instructed using a model classroom approach to teach a problem-based learning technique. The course had a length of five days. She emphasised teaching theory with hands-on activities and developing classroom curriculum during the course. The goal of the program was to teach problem-based learning teaching strategies to educators. She achieved this objective by explaining problem-based learning to the teachers and then having them participate in an activity dealing with a problem. Then she assigned a long-term project for the teachers to develop a lesson plan on problem-based learning to be incorporated into their own curriculum. She finished with a final assessment and had the teachers evaluate their own experience with the course. Sage states that important aspects of her course that ensure its effectiveness are as follows:

- The teachers encounter the technique as both teachers and as students, which allows them to understand and evaluate the technique from the different perspectives.
- A specific time frame is important to the course. Participants and instructors should be aware of this timeline during the entire program.

- Opportunities should be included in the course for the participants to reflect and absorb the new materials being learned.
- The instructor should maintain a warm, supportive classroom atmosphere, especially when teaching material similar to problem-based learning techniques, which have been found to be frustrating material to the students.
- A small classroom of 10-15 students is important for the necessary attention to be given to each participant.
- The discussion and utilisation of options and examples for the techniques are very important to allow the participants to implement them into their own classrooms.
- A pre-test and post-test are effective to evaluate how effective the course was in educating the participants and to improve the course from feedback. The pre-test also allows the instructor to modify the course to the needs of the current participants.

(Sage 2001)

Two organisations, the Quality Teaching Program (QTP) in Australia and the Finance Project in the United States, conducted research on successful professional development programs. The QTP (2001) found that a defined timeline is important to a program. The timeline should benchmark the goals of the program and be shared with the participants of a program. The QTP emphasises this point because it could assist with the internalisation of the course goals by the participants. The Program also reaffirmed the generally accepted practice that specific relevance to a teacher's field should be emphasised in conjunction with the practical applications therein. Finally, the QTP stresses a final evaluation of a professional development program in order to understand its value to educators (Johnson 2001). The Finance Project (2001) was a national initiative researching different aspects of professional development in education. One project (Finance A 2001) created the following list of effective professional development program characteristics:
- Extended duration
- Clear purpose
- A connection to a school or district's theory of change
- Drawn from a clear vision of teaching and learning and containing well articulated goals
- Flexibility in form and a willingness to reflect and change
- Collaboration
- Supportive leadership, reliance on proven theories of adult learning
- Research based
- Strong content
- Aware of and responsive to context

The Finance Project developed this list from an analysis of literature on professional development from across the United States. The list appears to be based on a comprehensive foundation of background research and may serve as an effective starting point for considerations in creating professional development frameworks.

2.2.4 Summary of Features and Techniques

There are several main components of professional development programs on which experts agree. There is an explicit emphasis on a well-defined timeline, as well as the development of classroom materials during the program, and a final assessment to test the effectiveness of the course. Relevance of the course material to the teachers and to their curriculum also appears vital. It is generally accepted that if the professional development does not have practical applications for its participants, it will not be successful.

Different education techniques may have an impact on the success of a professional development programs. Also, different delivery mechanisms could influence the programs' long-term effects. Flexible delivery options are possible methods for meeting the needs of working professionals. Furthermore, problem-based learning appears to foster the integration of real world relevance with the education process. According to Bottomley (1999), off-campus study, on-line courses, and modular curricula are all frameworks that appeal to the need for flexible schedules within professional development programs. The multiple delivery mechanisms promote different necessary features of a professional development program.

2.3 Educational Structure, Curriculum, and Professional Development Requirements

Because of the certification requirements for Australian mathematics teachers, these educators often do not have the necessary statistical knowledge to incorporate statistics into their teaching (Trewin et al B 2003). A possible result of these missing skills is the lack of statistical focus found in the classroom, which corresponds to Australian students having a decreasing interest in statistics (Canberra Times 2004). In order to gain insight into this problem, we will outline the organisation of the Australian education system. We will also discuss the nature of the United States education system to use as a reference of comparison to that of Australia. This comparison will highlight the variations between the two systems.

2.3.1 Australian Education System

Australian school systems consist of a preparatory year, sometimes referred to as Kindergarten, followed by twelve pre-university years of education (AU DE 2005); each year is labelled according to its corresponding year number. Schooling begins with the primary years, kindergarten through year 6. From approximately ages 12 through 18, the students are in secondary schooling, which consists of years 7 to 12 (DoE AU 2004). Years 11 and 12 are sometimes referred to as college years. The transitional years between the two separate divisions are known as the *middle years*, which are generally considered to be years 5 through 9 (Lalor West nd).

There are eight states and territories in Australia, each of which has its own Department of Education with its own standards. With so many regional departments, coupled with the existence of a National Department of Education, there is a multitude of curricular requirements to consider (Victoria 2002). The states are divided into districts and regions; the school boards of each region decide their own local curricula and frameworks. For example, Victoria has the Curriculum Standards Framework (CSF), which outlines what will be taught in each key learning area, beginning with kindergarten and progressing through primary to secondary school (Victoria 2002).

During the past thirty-five years there have been various movements in Australia for establishing a national curriculum, but these efforts have met with little success. Presently, there are attempts on a national scale to develop and maintain a consistent connection. The National Literacy and Numeracy Week, an Australian national government initiative, is an attempt to create a cooperative movement among the various school systems (AU Government 2005). Another national organisation that has a direct role in the education of the children is the Ministerial Council on Education, which is composed of all the ministers for the different states and territories. The Council makes general education policy suggestions. For example, in 1997, the Council stated that "...every child leaving primary school should be numerate and be able to read, write and spell at an appropriate level" (National Report 2001).

In 2005, the National Department of Education conducted a study entitled "Rethinking National Curriculum Collaboration: Towards an Australian Curriculum" and arrived at the conclusion that the development of a national curriculum is crucial for the improvement of the Australian educational system as a whole. This goal is seen as necessary for Australian education to be respected globally (DoE AU 2005). The National Department (2005) recommended that a national organisation such as the National Institute for Quality Teaching and School Leadership (NIQTSL) would be best suited towards meeting Australia's need for a national education system. A further explanation of the NIQTSL is given in section 2.3.2.

Essential learning has become a new focus in Australian education, and this new concept is spreading throughout the country. The emerging practice of essential learning is to focus education on the skill sets rather than content matter, so that students will be able to implement what they learn in their everyday lives, and their education is not limited to a school setting. Tasmania has already incorporated this system (DoE TAS 2005), while Victoria and New South Wales are working towards integrating it into their school systems (VCAA 2004, DoE NSW 2002). The Australian Capital Territory has incorporated essential learning titled key components into their education system (Hughes 2005). Tasmania's essential skills are divided into the following skill categories: thinking, communicating, personal futures, social responsibilities, and world futures (TAS DoE 2005). Similar skill sets are being developed in the other states and territories. In general, the focus on essential skills remains the same; however, each state adapts the goals to their own education requirements.

The Australian curriculum is currently organised into approximately nine key learning areas (KLAs); this number varies with each state or territory. In the middle years, students begin classes specifically focused on each KLA. The KLAs are typically English, Mathematics, Science, History, Geography, Technology, Physical Education and Health, Languages, and the Arts (Ruse Public nd). Each region groups the KLAs in a slightly different manner, but the fundamental concepts are maintained on a national scale (Victoria 2002).

It is difficult to compare certain KLAs nationally, because each of the states tends to focus on different aspects of the KLAs. However, the mathematics KLA seems to be fairly consistent; the information taught is constant for the same year levels throughout Australia. In general, mathematics is divided into five specific categories (VIC CSF; DoE WA; DoE TAS). The areas *Numbers*, *Measurements*, *Chance and Data*, *Space*, and *Algebra* are individually benchmarked according to curriculum standards. Examples of these benchmarks for South Australia and Victorian are located in Table 1 (page 13).

The mathematics KLA is specifically mapped out for each required skill set. The *Numbers* section covers basic probability. The mathematics subdivision currently being taught on *Chance and Data* can be a key background for statistics. (VIC CSF 2004; DoE WA 2004; DoE TAS 2005) However, teachers' backgrounds lead them to be more knowledgeable in the other areas of the KLA (ABS 2003). This relative inexperience could lead to less class time being spent on these statistics related subjects and more on areas of strength.

2.3.2 The United States Education System

In the United States there are also thirteen years of education before the college level, beginning with elementary school, which consists of kindergarten through sixth grade (K-6). The ages of these students range from four to twelve years old. Next is middle school, a two-year transition period composed of seventh and eighth grades; students are typically twelve to fourteen years old during this time period. The later elementary grades and middle school correspond to the Australian middle years; at the middle school level, subjects are divided into separate courses, similar to the Australian approach. Finally, high school education consists of grades nine through twelve, at the end of which students are approximately eighteen years old.

American mathematical literacy goals can be used as an effective basis of comparison for understanding the desired level of statistics in another country. Benchmarks for Science Literacy: Project 2061, which was first published in 1985, is a study of curriculum design and the education system in the United States. This project connects curricula across the United States. Benchmarks focuses on "what all students should know and be able to do when they leave high school" (Benchmarks 1993). The five main topics in mathematics are "numbers, symbolic relationships, shapes, uncertainty, and reasoning" (Benchmarks 1993). In the United States, by the end of eighth grade students are required to have a familiarity with negative and positive numbers along with computations, basic algebra,

geometry of lines in multiple dimensions, and the beginnings of probability (Benchmarks 1993). Focusing on statistical knowledge and literacy, Table 1 lays out the goals outlined for probability and statistics in the United States and shows the equivalent Australian curriculum standards for two states.

Table 1: Middle Years Curriculum Frameworks for Probability and Statistics in the United States, South Australia, and Victoria
(Benchmarks 1993; SACSAF2005; VCAA 2004)

United States Benchmarks for 8th Grade in Probability and Statistics	South Australia Curriculum: Key Ideas for Year 8 in Exploring, Analysing, Modelling Data	Victorian Curriculum & Assessment Authority: Learning Outcomes for Year 8 in Chance and Data
- How probability is estimated depends on what is known about the situation. Estimates can be based on data from similar conditions in the past or on the assumptions that all the possibilities are known. - Probabilities are ratios and can be expressed as fractions, percentages, or odds. - The mean, median, and mode tell different things about the middle of a data set. - Comparison of the data from two groups should involve comparing both their middles and the spreads around them. - The larger the well-chosen sample is, the more accurately it is likely to represent the whole. But there are many ways of choosing a sample that can make it unrepresentative of the whole. - Events can be described in terms of being more or less likely, impossible, or certain.	- Students engage with statistics by formulating and answering questions, and collecting and representing data in order to investigate and understand the world around them. - Students use statistical methods to reduce, analyse and interpret data, while critically evaluating the culture and social inclusivity of the samples used. - Students engage with the data to understand, analyse and apply notions of chance and probability in the social and natural worlds.	- Chance: Analyse experiments to determine the theoretical probability of events and carry out experiments involving chance to estimate the probability of events and stimulate situations - Posing Questions and Collecting Data: Decide on the nature of the data required to effectively answer specific questions and plan ways to collect and organise it and obtain data related to an area of interest - Summarising and Presenting Data: Present collected data in tables, databases and spreadsheets, present univariate data using graphical techniques and technology, and summarise the data set by obtaining measures of central location and spread 'by hand' and using technology - Interpreting Data: Interpret and evaluate information contained in tables and visual displays and databases and report on the methods of data collect, interpret simple measurements of location and spread and use them in a comparison, draw inferences from collected or published data, and make predictions on the basis of samples.

2.3.3 Educational Professional Development Standards and Requirements

While professional development is encouraged on a national scale in Australia, national professional development requirements do not exist (NIQTSL 2004). However, there still exist standards on the state and local level similar to those found in the United States. Professional development goals in Australia are based on the learning objectives for the students; programs are designed based on the desired areas of improvement (NIQTSL 2004). Professional development programs for teachers are created to strengthen the areas that are found to be less than adequate. Districts are encouraged to sponsor professional development programs for their teachers, the point of which is to fashion a professional development program that is tailored to the teachers' needs (QTP 2003).

Currently in Australia, each state Department of Education has its own its requirements for educational professional development. However, there is a movement to create a nationwide standard. In the middle of 2004 the minister of the National Department of Education created a plan with the goal of assembling a national organisation for professional development standards in education. The role of the National Institute of Quality Teaching and School Leadership (NIQTSL 2004) is to provide national guidelines for professional development. While the NIQTSL is still in the early stages of development, its goal is to be fully functional by the end of 2005. It has been created on a national level, but it is still a work in progress from state to state (NIQTSL 2004). The guidelines set by the Institute should be considered when creating any new professional development program, in anticipation of its full implementation. At the moment however, the organisation responsible for professional development on a national scale is the Quality Teaching Program (QTP). This organisation works to provide professional development frameworks to Australian teachers and to improve curriculum development (QTP 2003).

The QTP has programs and goals similar to those of the United States. In the United States, professional development is designed based on the needs of the students. There is a national requirement for professional development for teachers, but the enforcement exists on the state level. Furthermore, the states encourage individual districts to be responsible for their own professional development initiatives. Table 2 (page 15) shows requirements for professional development programs in Connecticut and Massachusetts.

It can be noted that while the two states use slightly different wording, and the information is presented in a different order, many of the requirements are the same for teachers in both states. Differences, however, do exist between the two states' requirements, which highlight the need for an understanding of local priorities. In Massachusetts, for example, the emphasis is on professional development standards that are nationally recognised, while Connecticut focuses on simply meeting conditions at a local level. This difference is a result of the Education Departments functioning in the two states. According to a study done by the Finance Project in 2002 titled *Profiles of Selected Promising Professional Development Initiatives,* Connecticut's professional development program and teacher requirements are very strict. In fact, Connecticut will only hire teachers who have been certified to teach in Connecticut (Finance Project 2

2002). Despite these differences, it is important to acknowledge the similarities. Both programs emphasise teacher goals in connection to the school district and a broader curriculum, professional development for the benefit of students, and personal growth on the part of the teachers. These standards could be compared to the Australian state standards in order to discover motivating factors for professional development initiatives.

Table 2: Professional Development Requirements
(Connecticut 2002 & Massachusetts nd)

Professional Development (PD) Requirements on the State Level:	
Connecticut:	**Massachusetts:**
- PD is focused on building the capacity of teachers to improve student learning (individually, in small groups, and as members of a school community).	- Is the plan consistent with the subjects or topics included in the school and/or district plan?
- PD options are based on teacher growth needs.	- Do the proposed activities address areas of need in terms of student learning?
- PD directly supports teacher goals, which are linked to school goals.	- Can a clear link be established between proposed activities and student learning?
- PD reflects the accountability system built into the school and district system i.e. is job-embedded and reflects the expectations.	- Will the plan improve student learning at the grade level and subject area of the educator's primary teaching assignment?
- PD is purposefully linked to the CCT or the SSL.	- Has the educator identified professional development goals prior to identifying proposed activities?
- PD plan includes programs that showcase best instructional and leadership practices.	- Has the individual considered his own professional development needs within the context of t the school and district goals?
	- Is there flexibility within the plan to accommodate modifications over time?
	- Will the proposed activities add to the educator's repertoire of skills and content knowledge?
	- Is the educator planning to participate in a range of meaningful and professionally relevant professional development during the re-certification cycle?
	- Do the proposed activities address the Professional Standards for Teachers?

3 Methodology

The goal of this project was to design a professional development framework that includes recommendations for content, delivery mechanisms, and distribution paths, with the purpose of creating an effective and appealing program tailored towards teaching statistics to middle years mathematics teachers throughout Australia. This chapter outlines the methods that were used to gather and analyse information pertinent to the design of a professional development framework. First, we describe the steps taken to discover educators' opinions on effective professional development. Next, we elaborate on the methods used to determine successful techniques in professional development as well as the various paths of distribution that a program can follow. Finally, we discuss the processes used to discern the costs of the assorted delivery mechanisms and weigh them against their potential benefits.

3.1 Teachers' Preferences for Professional Development Programs

In this section, we explain how we explored the opinions of our target audience, middle years mathematics teachers. The following research questions guided our methods:

- What are the teachers' preferences with regards to professional development programs?
- What are the teachers' experiences, both positive and negative, in professional development programs?
- What delivery mechanisms would inspire interest in a particular professional development program?
- What type of content would teachers prefer to have contained in a statistics-based professional development program?

In order to ascertain these opinions, we used a combination of a survey of United States middle school mathematics teachers in a professional development course and two focus groups comprised of Australian middle years mathematics teachers. The objective of the survey was to gain a collection of general opinions on these topics; this information was then used to develop the structure of the focus groups.

The survey was designed to gather the opinions of teachers with respect to our four research questions. Because of the timeline of the project and the resources currently available in the initial stages, we organised the survey in February 2005. We conducted a survey of participants in a professional development course being taught in the United States, at Worcester Polytechnic Institute, by Professor John Goulet. This group was chosen because of its similarity to our target audience. The course served as an in-depth exposure to middle school level algebra for mathematics teachers, and its goal was to teach content information, not education techniques. The survey was two pages in length and consisted of a combination of multiple choice, scaling, and open-ended questions. Because a large number of the participants were taking the course over the Internet, the survey was administered via email. The surveys focused on teaching experience and professional development experiences. We inquired about the backgrounds of the teachers so that their professional development experiences could be assessed based on

their relative experience levels. Also, when the teachers ranked their preferred professional development delivery mechanisms we considered these preferences in light of the types of mechanisms that they had experienced. This method was selected because it was capable of gathering a large number of opinions relatively quickly with the appropriate target audience. The survey and results are included in Appendix B.

In order to gain further insight into the teachers' opinions, we expanded upon the information gained through the surveys by conducting two focus groups with teachers from metropolitan secondary schools in the Western, Northern, and North-eastern Districts of Victoria. Teachers enrolled in the focus groups on a voluntary basis, after receiving an invitation from the Australian Bureau of Statistics (ABS). The ABS sent these invitations to Victorian teachers who already had some connection with the National Education Service Unit. Seventeen people were included in the focus groups, eight in the first and nine in the second. The ABS compensated the participants for their time. Since the compositions of the two focus groups were similar and the protocol utilised in both situations was the same, we analysed the results of both focus groups in conjunction with each other.

Our goal during the focus groups was to gain information for compiling possible professional development frameworks from the teachers' perspectives. The questions were developed to address our four research questions. The focus groups allowed the teachers to respond to each other's ideas; the opinions gathered from a group discussion were helpful in broadening our understanding of why each particular approach is effective or ineffective. The use of this method led to a discussion and elaboration on each issue. In particular, we discussed professional development content and delivery mechanisms in relation to the teachers' past experiences. Focus group protocol and summaries are embedded in Appendix C.

The focus group protocol was developed in partnership with Peter Lucas, an ABS training facilitator, who moderated the groups. The focus groups were ninety minutes in length. Thirty minutes were devoted to an introduction and preliminary information gathering session; we used this time to learn about the different educational backgrounds of the teachers. The next fifty minutes were spent discussing delivery mechanisms and composition of professional development programs; the primary discussion point for program content was the balance between technical statistical knowledge and practical classroom application of that knowledge. The last ten minutes were used for a quick summary and wrap up, as well as any clarification questions that we had for the participants. All four team members attended the discussions; two acted as scribes and two as observers, with their roles alternating after the first group.

3.2 Exploring Effective Professional Development Techniques

The purpose of this section is to outline how we researched techniques practised in the design and structure of professional development programs. We used the following research questions to guide our exploration of this topic:

- According to professional development experts, what are the key components of an effective professional development program?
- How do experts go about creating professional development programs?
- In professional development experts' opinions, what types of professional development program frameworks have been effective or ineffective in the past?
- What are professional development experts' opinions of some common hindrances to the creation process?
- What, in professional development experts' opinions, are the positive and negative aspects of various mechanisms of delivery?
- What are the developmental and recurring costs inherent in these delivery methods?

To understand these topics, we chose to interview experts in the field of professional development who have participated in the creation of programs in the past. Additionally, we conducted qualitative research on various programs that have been created in subject areas pertaining to statistical literacy in order to understand the various techniques and practises that are already being applied.

The three professional experts interviewed were all designers of professional development programs in Australia at the time of the interviews (March-April 2005). Ian Wong was a consultant for the Victorian branch of the ABS. He was previously a mathematics teacher, a professional development coordinator, and a professional development designer. Jennifer Cook was a professional development expert for the Eastern Metropolitan region of Victoria. She was also a consultant for the Mathematics Teachers Association of Victoria. Michael Richards was a professional development consultant for the Southern Metropolitan region of Victoria.

A general protocol, included in Appendix D along with the interview summaries, was the basis for each interview. The interviews were then tailored to the individual expert's knowledge. With each of the experts, we discussed specific programs that he or she had designed in the past, as well as the impact of these programs. We then went on to review the resource requirements inherent in program creation. This information gave us insight into the techniques practised in the field of professional development.

To supplement these expert opinions, we also considered the descriptions of several Australian mathematics and science professional development programs. Aspects of these courses were analysed including the structure and the delivery mechanisms used in each of the programs. Further research was conducted to discover the necessary resources required to create professional development programs that use these methods.

3.3 Investigating Professional Development Distribution

Here we explain how we considered and evaluated the various available methods for distribution of a professional development program and how these methods could impact the success of any given program. The following research questions guided our analysis in this area:

- How are professional development programs recommended, evaluated, and selected?
- What are the primary features sought after in professional development programs?
- What are the governmental standards that influence professional development participation?
- How does the curriculum structure relate to professional development goals?
- What types of interaction and communication with regards to professional development exist between school systems and regions?
- What are the technological limitations involved with professional development in the different states and regions?
- What are the recurring costs inherent in the distribution of various programs?

To answer these questions, we interviewed administrators within the Australian education system who have experience distributing professional development. In particular, we consulted those people who assess professional development programs and decide whether or not to recommend those programs to the teachers. Additionally, we conducted research over the Internet and through various reports to find the governmental professional development requirements, both on a state and national scale.

We researched government regulations in order to understand the restrictions and driving forces behind any given method of distribution that could be selected. To accomplish this research, we used a combination of written resource reviews and informal telephone interviews with administrative members of regional and district departments of education. These techniques are generally effective at collecting factual data quickly.

To further our research into distribution, we aimed to discover how the administrative members of the Australian education system decide which professional development programs they recommend to their teachers and why they make these decisions. Although the goal of this project is to create a framework for mathematics teachers, the Departments of Education must approve the program. Since each department differs from region to region, contacting these decision-makers was a different process for each of the Australian states and territories. Contact was initiated through information provided on their respective websites. Through networking we were able to develop a list of associates; interviews were then organised with willing participants.

We conducted interviews with administrators located in several different regions throughout Australia. The interview questions were designed primarily to gather information on the process of selecting professional development. A secondary goal was to understand the coordinators' opinions on the different methods of delivering content to teachers, including various forms of electronic media and face-to-face seminars. A list of the administrators interviewed, their location, their title, and their responsibilities is given in Table 3 (page 20). The protocol used for these interviews is included in Appendix E.

Since the professional development framework needs to be applicable across Australia, the feasibility of distribution methods will depend on Australia's technology. We researched what technology was available in all regions, so that the program might reach as many potential targets as possible. This information was found in parallel with the

government regulations during the same informal telephone interviews with administrators. An overview of all data collection methods can be seen in Figure 1.

Table 3: List of regional professional development coordinators

Name	State or Territory	Title	Responsibility
John Coleman	Queensland	District Coordinator for Rockhampton	Distributor of professional development programs
Richard Grey	Western Australia	Principle Curriculum Officer for Government Schools	Incorporation of curricula by schools and the required professional development programs
Bruce Hughes	Australia Capital Territory	Professional Learning Sector of the ACT Department of Education	Develops and distributes professional development programs
Nathan Pirouet	Victoria	Professional Development Coordinator for Cowes Primary School	Screens and distributes professional development programs for teachers
Allison Stuart	Victoria	Professional Development Cluster Coordinator for Gippsland Region	Head of Gippsland region professional development and professional development trainer
Neil Thorpe	Queensland	District Coordinator for Tom	Distributor of professional development programs
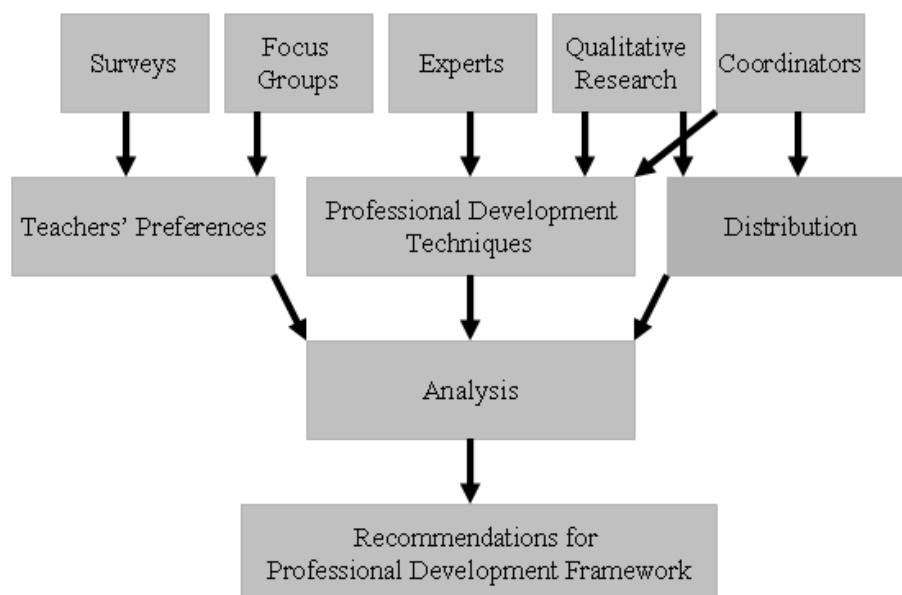
Figure 1: Outline of methodology.

3.4 Analysing the Findings

The purpose of this step was to evaluate the results of the research described in the previous sections as a whole and assess the information in those results. We divided the professional development framework into the following three mutually exclusive elements:

- Content – the material presented to participants in a professional development course
- Delivery – the mechanism by which content is presented to participants
- Distribution – the path that the professional development course takes from the Australian Bureau of Statistics to the participants

We assessed each of the above components based on the following criteria:

- Will the program be effective in educating the target audience (based on expert opinions)?
- Will the program appeal to teachers?
- Will the program appeal to administrators?
- Will the program reach a sufficiently large audience?
- Are the development and implementation costs within the resources of the Australian Bureau of Statistics?

To analyse content, we first identified the possible features that a professional development program could incorporate based on the teacher and expert opinions. Between these two sources, we found the primary elements that were generally agreed to be the most vital aspects of a professional development course.

Delivery was analysed in three separate categories, including primary delivery mechanisms, teaching strategies, and professional development course structure. The three main delivery mechanisms considered were web-based applications, compact disk independent study courses, and face-to-face programs. We considered each of these based on the five criteria above using a decision matrix. To assess teaching strategies, we first compiled a list of possible techniques that were mentioned by any of our sources. We then considered each of these methods using the same decision matrix mentioned above. Finally, we analysed the structural components of a professional development program by finding the points of consensus between experts and teachers regarding the number of classes, the time spent in each class, and the number of participants.

We also complied our data on cost for the three delivery mechanisms. Expenses were divided into two components: developmental costs and recurring costs. In order to gauge the impact of cost, we took an existing face-to-face professional development program and dissected it into its separate expenses. To compare developmental costs, we factored in the additional program developers and graphics designers required to transfer content into an electronic format. The same process was undertaken with recurring cost; after uncovering this initial cost, we estimated necessary resources required for the other delivery mechanisms to reach the same target audience. Since we did not investigate

program content development, only development of a framework, it was impossible to predict exact values for developmental and recurring costs.

To analyse distribution, we first compared the data gained from each of the administrator interviews and our other qualitative research. We identified the possible paths that the program could utilise. We then organised these paths into the form of a flowchart, tracing each path from the end of development to implementation. For each of the paths on the flowchart, we outlined the advantages and limitations in order to assess that path based on its ability to impact the largest target audience.

4 Options for a Professional Development Framework

This chapter reports on the findings that were compiled to complete our goal of recommending an effective professional development framework. Our findings are discussed for each of the following mutually exclusive topics: content, delivery, and distribution. These results formed the basis upon which we made our recommendations.

4.1 Content

We define the *content* of a professional development course as the material presented to the participants. From the perspective of this project, content is the foundation on which a professional development program is built. Focus group discussions indicated that the material included in the program can be separated into several areas, including theory, classroom practices, practical applications, and feedback and follow-up.

Theory, in terms of this project, is the knowledge about technical aspects of statistics, such as mean, median and mode. In our research, we found that there was a consensus about the need for theory in professional development classes. However, the teachers surveyed, focus group members, and experts interviewed differed in opinion on how comprehensively the material should be covered. Some experts and participants in one focus group stated that a background refresher was sufficient, while some other focus group participants claimed that they required a more in-depth session of theory, since they would prefer to be more knowledgeable on the subject than their students.

Our preliminary survey results indicated that information about *classroom practices*, which are classroom materials and educational techniques, is necessary for successful professional development. Focus group participants and the experts interviewed supported this finding. Classroom materials are supplemental resources given to teachers at the conclusion of a professional development program that can be incorporated into classrooms. Educational techniques are the ways in which a teacher can present information to his or her students.

All of our sources agreed that teachers benefit from materials and lesson plans created or given to them during a professional development course. The differences in opinion occurred in how this material should be delivered to the teachers. Some participants from the focus groups wanted to be handed a packet of materials that they could immediately incorporate into their classrooms. Most other sources stated that the teachers should develop a lesson plan during a professional development program.

Educational techniques are the different methods that teachers can utilise to present information to their students. Qualitative research suggested that teaching new techniques to educators should improve the students' learning experience. There was a uniform consensus among our sources that knowledge received from a professional development course needs to be easily integrated into the current curriculum, with minimal restructuring. According to the focus group teachers, by showing applicable classroom

practices, teachers will not be required to develop new techniques before they can implement the new material in their classrooms.

The use of *practical applications* in professional development is important to teachers because practical applications illustrate how statistical theory relates to everyday experiences. The focus group participants and experts interviewed held that interest in statistics could be improved if a professional development course provided real-world examples of the data; qualitative research also supported this concept. Some members of the focus groups stated that the applications should be interesting to the students, but that the teachers did not necessarily need to be interested. Other participants disagreed, stating that the real-world applications should be important to them, and that they in turn could foster interest in their students.

All of the experts interviewed recommended that any professional development program incorporate some feedback from the participants and follow-up from the instructor. The feedback serves to help the instructor gauge the progress of the participants and adjust the presentation of the course accordingly. There were two different methods specified by the experts interviewed and focus group members for gathering feedback. If the course spans a few weeks, giving feedback to the instructor between each class allows for more immediate adjustments. Receiving feedback from the participants a few weeks after a course culminates is useful for making adjustments to a program. The follow-up assists participants in successfully incorporating the new material into their classroom; in interviews, experts stated that follow-up should occur during and after the course.

4.2 Delivery

Delivery was defined, for the purpose of this study, as the mechanisms that would be used to present content to teachers participating in a professional development course. We divided the different approaches for delivering a professional development program into the following three categories: web-based applications, independent study programs, and face-to-face interaction. In this section, we will summarise the delivery mechanisms and describe the advantages and drawbacks of each delivery method.

4.2.1 Web-based applications

Web-based applications have become increasingly prevalent; the Internet can be used efficiently in reaching large populations over a vast geographic region. Qualitative research revealed that rural schools throughout Australia receive specific funding for distance learning technology because it is difficult for teachers in these schools to attend professional development programs. This trait makes web-based programs very attractive when considering distribution methods for a professional development course. Also, one expert explained that a web-based application could be developed to be interactive with its user, enabling participants to adapt the program to their needs. According to qualitative research, focus group participants, and experts interviewed, it is very

important that a professional development program should be designed considering teachers' time constraints. Focus group members explained that with teachers' current workloads, it is difficult for them to find time to work on professional development. However, qualitative research suggested that web-based programs are able to adapt to participants' schedules, allowing for greater flexibility than would be found in face-to-face professional development program.

Many teachers in the focus groups stated that they are reluctant to download large amounts of information from the Internet because of the high cost involved. Also, focus group participants expressed concern with utilising web-based applications, many stating that they were not comfortable using web-based applications on an individual basis without training. The experts interviewed expressed the same concerns as the focus groups, stating that programs utilising technology first need to education the participants on the technology before they can participate in a web-base course. Participants in both focus groups came to the consensus that if they encounter an obstacle in a web-based course, they usually give up instead of working through the problem. Members also stated that when working independently they are easily distracted by outside work and tend to switch their focus onto a new task.

Qualitative research discovered that the National Education Service Unit provides lesson plans for teachers on the Australian Bureau of Statistics' website. The ABS also makes Australian statistics readily available on its website. Some of the participants in the focus groups had attempted to develop lesson plans from online ABS resources but were not successful. There were several possible reasons provided to explain this lack of success. The participants found the ABS website difficult to navigate, resulting in many teachers giving up before locating the desired data. Additionally, those participants who did find data found it in a form that was not practical for use in a classroom setting. Finally, the teachers did not use the lesson plans provided by the NESU because they wanted lesson plans developed specifically for use in their curricula. Experts interviewed claimed that it is more effective to have teachers develop their own lesson plans. Qualitative research supported this statement by suggesting that teachers learn material better and have more success utilising it in their classrooms if they assemble it themselves.

4.2.2 Independent Study Programs

Independent study programs are designed for participants to learn the subject matter without the aid of an instructor. Independent study programs have the advantage of allowing the participant to adjust the course to his or her own schedule. There are many types of independent study programs; for this project, we focused on compact disks (CD) as our delivery mechanism. Because of the availability of personal computers, CDs are an accessible technology throughout Australia. In the Victoria, for example, teachers are required by the Department of Education to have laptops. According to an ABS information technology consultant, an advantage that compact disks have over web-based applications is the amount of information that can be distributed. He explained that

teachers using CDs would not have to pay to download large materials because the information will already be on the disk.

The focus group members stated that they do not like studying on their own time. Furthermore, experts interviewed agreed that it is more productive to take teachers out of their normal classroom environment to avoid distractions. Another disadvantage to these types of program is that it is more difficult to provide interaction or collaboration between teachers than in other delivery methods. As outlined previously, a majority of the focus group members stated that they do not want the responsibility associated with using technology without the proper instruction. A possible illustration of this reluctance is a professional development course offered in Queensland using this form of delivery. According to the professional development coordinator interviewed in that region, compact disks were tested and found to be an ineffective method of delivery because they were not utilised by the teachers.

4.2.3 Face-to-face Interactions

The final delivery mechanism that we considered was *face-to-face* interaction, which we defined as a form of professional development in which the participants and the instructor meet and interact on a personal basis. Face-to-face interaction can take advantage of numerous teaching styles and can be adapted to various situations depending on the structure of the professional development course. The use of different teaching strategies in a face-to-face program will be elaborated upon in Section 4.2.6. Experts interviewed stated the number of participants present during a program is the largest limiting factor to the techniques that can be utilised by a course delivered through face-to-face interaction.

The teachers with whom we spoke expressed a preference for face-to-face professional development courses for many reasons. They claimed that the presence of an enthusiastic instructor in front of the teachers could motivate participants to learn the new material. Additionally, the teachers stated that another benefit of face-to-face interaction is that it takes place away from the teachers' classrooms. Both focus groups and experts commented on the fact that it is difficult to concentrate on a professional development course if the participants have work-related distractions. More specifically, the focus group participants stated that they were immersed in after-school work, which monopolised most of their time.

According to the focus group participants and teachers surveyed, the time constraints under which teachers operate have a detrimental effect on their ability to attend face-to-face professional development programs that span multiple days. Teachers agreed that one-day face-to-face programs tend to have little impact on their ability to educate. These programs do, however, satisfy their professional development requirements and have a limited impact on their schedules, which is why they attend one-day face-to-face programs at all.

4.2.4 Cost Analysis

Each of the three delivery mechanisms has two separate expenses: one time costs and recurring costs. The cost analysis was based on the assumption that the program should reach approximately 800 participants. This number was chosen because we were informed that there are 120,000 teachers in Australian. Since the NESU is targeting only middle years teachers, we then divided the total number by three. Then we assumed that mathematics teachers compose approximate one fifth of the middle years teacher population. Since we hope that any program developed will influence about ten percent of the target audience, we concluded that program should reach about 800 middle years mathematics teachers. The one time costs associated with a professional development program consist of the research, development, and production. The recurring costs include instructor salary, maintenance, and venues. Some of the expenses were not associated with all of the delivery mechanisms. Using estimates for the each delivery method, we were able to see how the three separate mechanisms compared to each other.

We chose an interactive website as the delivery mechanism for a professional development program using web-based applications. Our cost analysis found interactive websites to be the least expensive option. The research costs for finding preliminary content requirements were estimated to be approximately $250,000. This estimate was based upon the budget of a professional development course given previously. Through collaboration with a professional development expert and an information technology consultant, developmental costs were approximated to be $175,000. The information technology consultant predicted recurring maintenance expenses to be $10,000 per year.

For an independent study program, we selected compact disks (CDs) as our delivery mechanism. The expenses inherent in a CD-based professional development program are slightly higher than those found for a web-based application. This difference is because of higher developmental expenses and the cost incurred due to the physical production of CDs. These expenses were estimated at $250,000 and $8,000 respectively. However, CDs have no recurring expenses.

We decided to analyse two possible face-to-face programs, including three-day and five-day courses. Research costs were the same for all three delivery mechanisms. However, developmental costs were estimated at $50,000 because the media does not need to be converted to a digital format. Production costs were not applicable for this method. We estimated instructor salaries by making the following three main assumptions: there would be one full-time instructor for the course, the program would take two years to reach the target of 800 participants throughout Australia, and that an annual salary for a professional instructor who is a statistical expert would be $100,000. We multiplied the salary by one point seven five to account for benefits, travel, supervision, and other additional costs. We assumed that classes would consist of fifty participants, which would require suitable venues. As a result, we estimated venues at $3,500 per day. So the

venue expenses were estimated by multiplying the cost per day, the number of days per course, and the number of courses per year.

For total cost, we combined the one time costs with the recurring expenses for two years. The face-to-face program appears to be almost twice as expensive as the other two delivery options. Also, these estimates are based on meeting the smallest target audience. For the face-to-face program to successfully impact more teachers, the cost would increase. However, this rise in expenses would not be as substantial in a CD or interactive website. Table 4 summarises our cost analysis and the results.

Table 4: Cost Analysis

Costs to reach 800 teachers				
	Web-based Applications	**Independent Study**	**Face-to-Face Interaction**	
	Interactive Website	**Compact Disks**	**Three-day**	**Five-day**
One time costs				
Research	$250,000	$250,000	$250,000	$250,000
Development	$175,000	$250,000	$50,000	$50,000
Production	N/A	$8,000	N/A	N/A
Total One time cost	$425,000	$508,000	$300,000	$300,000
Recurring costs (per year)				
Instructor Salary	N/A	N/A	$175,000	$175,000
Maintenance	$10,000	N/A	N/A	N/A
Venues	N/A	N/A	$84,000	$140,000
Total Cost	$10,000	N/A	$259,000	$315,000
Total Cost (For a program running 2 years)				
	$445,000	$508,000	$818,000	$930,000

4.2.5 Teaching Strategies Utilised in Delivering a Professional Development Program

Teaching strategies are the techniques used by a professional development instructor to educate participants effectively. Various education techniques were mentioned by several sources; these techniques include but are not limited to model classrooms, role reversal, internalisation of goals, teacher and expert facilitation, group work and collaboration, networking, lesson plan development, and hands-on activities. These techniques are types of flexible learning, which according to our qualitative research, are an effective means of education. These strategies and the rationales behind using them will be discussed in this section, and a summary of the strategies will be presented.

The concept of a *model classroom* is a technique in which the instructor organises the professional development program similar to the way in which the participants should organise their classrooms. Qualitative research found model classrooms to be an effective method for instructing teachers on different education techniques. Focus group participants stressed their preference for experiencing model classrooms during a professional development course.

Role reversal, a similar concept to a model classroom, is where the teachers assume the role of their students and experience activities as the students would experience them. Role reversal was recommended by a majority of focus group participants and experts interviewed as a successful ways in which to educate teachers. The experts and focus groups we talked with recommended this method because it can show the participants how a technique functions in an actual classroom, and can demonstrate the possible impact of that technique on students. Furthermore, the teachers discussed that participating in a classroom environment would allow them to see how to integrate techniques into their own classrooms. The two strategies mentioned above would only be effective in a face-to-face delivery mechanism because they require an interaction between instructor and participant.

Practicing teachers and professional development trainers with statistical expertise present two options for a professional development instructor. Focus group participants and experts interviewed claimed that a specialist in the field of statistics would be necessary for teaching a professional development program to our target audience. Inconsistencies arose between the two sources on whether or not this expert should also be a practicing teacher. The teachers in the focus groups were of the opinion that a practicing teacher was crucial for relating the material to classroom applications. One of the experts that we interviewed, however, expressed a concern that finding practicing teachers who are also statistical experts was unrealistic. Another professional development expert suggested that joint instruction between a practicing teacher and a statistical expert might be effective in the event that these qualities could not be found in a single instructor. This factor is only a necessary consideration when deciding who will facilitate a face-to-face professional development program.

All parties, including qualitative research, claimed that an *internalisation of goals* in a professional development program is necessary; the participants in a program should adopt the goals of the course as their own so that they have a clear understanding of its purpose. Qualitative research suggested that the internalisation of program goals would result in a greater long-term influence on the teachers. The focus groups stressed that having a practicing teacher instruct the program would result in more participants internalising the goals. While professional development experts agreed that an internalisation of the goals was important, they did not reach a consensus on an approach for successfully achieving it.

Qualitative research stated empathetically that an effective professional development program utilises collaboration between participants. There was also a general consensus that group work and collaboration within a professional development course have

significant impact on the short and long-term effects of a program.

Collaboration between teachers allows them time to discuss the program with their peers as well as create a network that could be utilised as a support structure after the program has ended. Participants in both focus groups, in addition to the experts that we interviewed, agreed that networking was an integral part to any professional development program. However, two of the experts asserted that successfully creating the network could be difficult. Some experts stated that the assembly of this network needs to be carefully monitored to make sure that it will be in place and utilised by the teachers after the conclusion of the course.

There was a consensus between all of our sources that taking materials back to the classroom at the end of a professional development course is essential. However, there was a difference in teacher opinions on how participants should receive the classroom materials. Some members of one focus group stated that they preferred the lesson plans to be provided at the end of the program. However, many experts and members of the other focus group, along with qualitative research, stated that the participants should create the lesson plans themselves within the professional development program. The experts interviewed, as well as qualitative research, suggested teachers would be more successful in integrating lesson plans into their curriculum if they had developed the plans themselves. The development of lesson plans could be completed successfully in a face-to-face delivery mechanism or a chat forum. An independent study or web-based application would present more difficulty in developing lesson plans within the program without an instructor to provide a guiding role.

Focus group participants and experts interviewed recommended hands-on activities and interactive learning. The experts explained that teachers are able to understand material better if they work with the information themselves. It was also recommended by qualitative research that hands-on activities be included with theory discussion in order to promote learning.

Throughout the interview process, experts and coordinators stressed that lecturing was an ineffective method for educating professional development participants. Qualitative research and teacher input supported this claim and suggested using active learning techniques as a substitute. As a result, while this technique could be utilised in a face-to-face program, it should be avoided.

In summary, our findings indicate that the following teaching techniques should be included in a professional development program: model classrooms, role reversal, internalisation of goals, group work and collaboration, networking, hands-on activities, and development of classroom materials. There was also a consensus that lecturing is not an effective education technique and should be avoided. Finally, it is important to note that four of the recommended techniques are only possible in a face-to-face course.

4.2.6 Program Structure

We define *structure* in our project as the organisation of a professional development course. The structure specifies how the program is designed in terms of timeline, number of participants, and flexibility. In terms of our framework, *timeline* is the span of a given program, including the span of hours a course spends per day, the number of times a course meets, and the period of time over which the program lasts. *Flexibility* is the ability of the program to adapt to changes, including different types of participants and updates of teaching strategies being utilised.

There was a consensus among our sources that if a professional development program is to have an effect beyond the course, then it must take place over an extended period of time. The focus group participants and teachers surveyed stated that a professional development class should not span one entire day. The professional development experts that we interviewed agreed with the teachers' opinion by reiterating that a full day conference was rarely effective in causing long-term impact on the participants. One expert stated that a single session would get the participants excited until they returned to the classroom, then the other demands and pressures would replace the professional development goals and nothing would result.

Qualitative research discovered that an effective professional development program should have an extended duration. All focus group members stated that the most successful learning process would take place over time; some teachers even suggested multiple professional development programs to insure that the participants incorporate their new knowledge into their classrooms. A relatively large portion of the focus groups stated an interest in taking a program over the course of multiple weeks. Each class in and of itself would be short in duration, but the time in between would give participants the ability to try out the methods and techniques that they learned during the prior session. Some of the experts interviewed emphatically agreed with this presentation format. It was found that giving participants several days to absorb the knowledge between sessions could prevent the information from being forgotten and increase the likelihood of long-term impact.

The focus group teachers and some of the experts and professional development coordinators interviewed emphasised the importance of *flexibility* in a professional development program. For this project, flexibility represents a program's ability to adapt, which is not a teaching technique but rather a component of structure. One professional development expert stressed flexibility in relation to the different participants of a program. She stated that it was very important that a professional development course adapt to the different backgrounds and learning styles of its participants. That same expert suggested a pre-test at the beginning of the program to allow the instructor to learn about the backgrounds of the participants and their learning styles. The instructor could then work to provide the information in a way that would coincide with the participants' learning styles and allow them to absorb more information from the course. The use of a pre-test was supported by qualitative research. Qualitative research also stated that the program should be updated and kept current for its participants. Professional development coordinators supported this position during their interviews.

4.3 Program Distribution

The ABS is required to provide equal access to its materials for every member of the Australian population (ABS Plan 2001). To address the need of equal access, we aimed to find a distribution path that reaches each region in Australia. *Distribution,* in terms of this project, refers to the path that a professional development program can take from the Australian Bureau of Statistics to reach its target audience. Each of the territories and states in Australia has a different process for the distribution of professional development courses, but all of these areas have central Departments of Education and Mathematics Teachers' Associations. These groups could be helpful in the distribution and promotion of any offered professional development courses. When assessing the possible methods of distribution, we considered the difficulty in contacting and working with the organisation and how effective the method is at contacting each region in Australia.

In order to distribute a professional development program through the Departments of Education, we found that it was necessary that the program meet certain standards. The Departments of Education for each of the states and territories provide their school systems with curriculum requirements. Each school uses these requirements to guide which professional development courses are selected by teachers. Along with the curriculum, each state Department of Education has an established method by which to distribute professional development from the central office to each school and then on to the individual teachers. Each system is explained in more detail in Appendix F. This method of distribution is effective because it can reach a large number of public schools through very few initial contact points. Furthermore, once the Departments endorse the program, the teachers will view it as a more worthwhile investment of time.

The Departments of Education are excellent partners through which to distribute a professional development program. This statement is based on the fact that most programs that are created by the Departments of Education tend to be delivered over an extended period of time. Also, if the proposed program meets the requirements of policies set by the Departments, they can provide funding for the programs. However, the proposed programs sometimes have difficulty being accepted by the Departments of Education.

Another way in which professional development courses can be disseminated to teachers is through the Mathematics Teachers' Associations. Each territory and state has its own associations; contact information can be viewed in Appendix G. These associations provide a direct link to many of the teachers that professional development programs aim to inform. However, membership in these Associations is not required, so they are not capable of contacting all Australian mathematics teachers.

The Mathematics Teachers' Associations have the ability to run professional development programs. The fact that they are non-profit organisations allows the Australian Bureau of Statistics to work in conjunction with them. Professional

development programs run through the Mathematics Teachers' Associations are usually one day programs. We assume that they are unable to hold courses with an extended duration because they are a non-profit organisation not affiliated with the government and do not have a large budget.

Another method of distribution is that of direct contact with the schools and teachers. However, professional development coordinators interviewed claimed that schools would be very sceptical of programs that are not sponsored by a reputable third party. Therefore, this method, while ineffective and inefficient for contacting all of the schools in Australia, could prove useful to contact those schools that are not encompassed by either of the two previously mentioned distribution paths. Figure 2 outlines the distribution paths explained above.
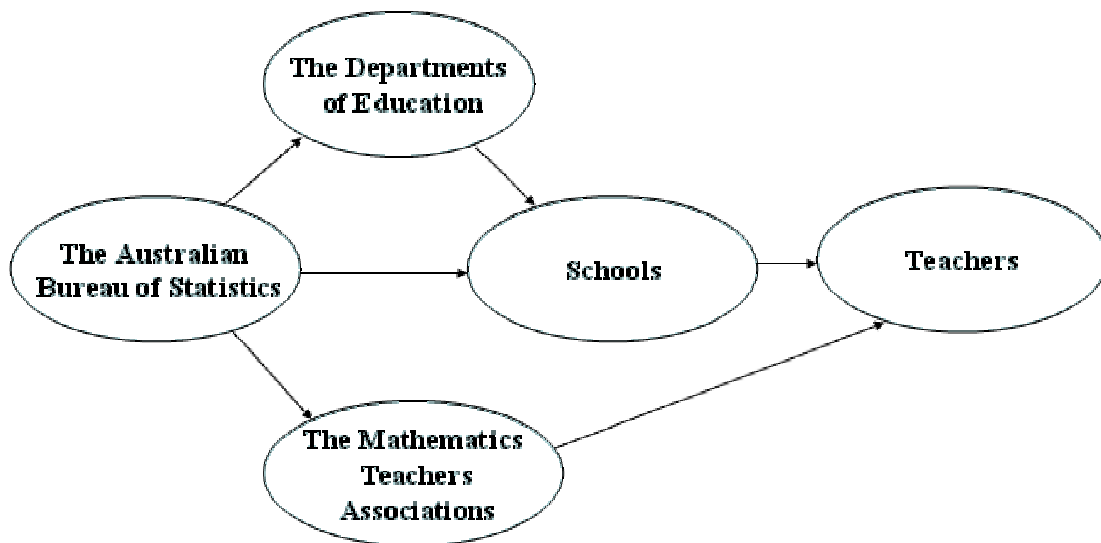

Figure 2: Distribution options for a professional development program.

5 Recommendations for a Professional Development Framework

This chapter discusses our integration of the data presented in the findings chapter and combines the information into a set of recommendations for the Australian Bureau of Statistics (ABS). This chapter begins with a section on the common distribution method that we recommend be used to implement any professional development program. The next section outlines strategies that the National Education Service Unit (NESU) could implement immediately to work towards their goal of improving statistical literacy in the middle years. The remaining sections contain two possible frameworks for professional development programs, one for an independent study program delivered through a compact disk (CD) and the other for a face-to-face delivery mechanism, as well as the steps that we recommend be taken to effectively implement each of them.

5.1 Important Attributes for Professional Development Programs

As indicated by our analysis, there are several significant components that contribute to the content of an effective professional development program. **We recommend that all professional development programs created by the NESU include a combination of effective classroom practices, middle years statistical theory, and practical applications of that theory.**

Our findings also indicated three possible paths for the distribution of a professional development program implemented by the Australian Bureau of Statistics. The first path involves contacting the schools throughout Australia directly; this method contacts the entirety of our target audience, but professional development programs that are not distributed through a reputable provider of professional development may be seen as unreliable. The second path available is to contact the state Departments of Education. Our analysis indicates that this method involves multiple stages of assessment, which could hinder the implementation of the program. However, since the Departments of Education are seen as reliable providers of professional development, this method of distribution stands a greater chance of success. The third path available is to contact the Mathematics Teachers' Associations across Australia. This method, while facing less bureaucratic restriction than the Departments of Education, stands to reach fewer teachers, as not all mathematics teachers are members of these organisations. Contacting the Mathematics Teachers' Associations could serve as an effective promotional tool that can supplement some other method of distribution.

To the end of circulating the program to a very large target audience with equal access for teachers in each state and territory, **we recommend that the NESU distribute any program created through a combination of the Departments of Education and the Mathematics Teachers Associations.** Contact information for these organisations can be found in Appendices F and G respectively. While the Departments of Education are able to provide access to all areas of Australia, publicising through the Mathematics Teachers'

Associations will provide an outside motivation for many of the teachers to participate in the professional development program.

5.2 Online Resources for Teachers

A wealth of knowledge can be stored online; the Internet is an efficient medium for archiving and distributing information. However, many participants in our focus groups stated that, when attempting to access the Internet resources made available by the ABS, they found the website confusing and difficult to navigate. Also, the teachers held that they were not able to successfully utilise the information available because of the confusing manner in which the data was presented.

Teachers have expressed a desire to have access to lesson plans using real-world statistics in their classrooms. Our findings show that aiding teachers to develop their own lesson plans is more effective than providing them with lesson plans that have already been assembled.

We recommend that the Australian Bureau of Statistics work to improve the usability of the resources already available to teachers on their website, and to expand those resources, as teachers have expressed an interest in using ABS materials to develop lesson plans relating to statistical literacy. The first step should be to make the website easier to navigate; some teachers have attempted to access the site for information to use in the classroom but have been unable to find this information. The second step should be to create an online tutorial for the development of a lesson plan based on ABS resources. Some teachers have expressed a disinterest in learning through web-based programs because they view them as a potential waste of their own time. However, this tutorial would be targeted towards teachers who have already decided to devote their own time to using ABS resources for classroom applications. As a result, an online lesson plan tutorial is expected to be effective because it would serve to aid teachers in accomplishing a goal that they have already elected to pursue. Furthermore, this tutorial can serve as a supplementary tool when an actual professional development program is implemented.

Collaboration and networking between participants during a professional development program was also highly favoured in our findings. Experts stated that if a network between teachers could be established, they would be able to use each other for support to clarify points of confusion or develop classroom materials. The Internet's ability to send and receive information on a global scale has had some impact on most aspects of education from research to teaching. Internet access allows for a networking of individuals over a large region; online discussion forums may be useful for collaboration. **We recommend that a discussion forum be implemented on the ABS website, and that participants in any professional development program be introduced to and trained in the use of this technology for their own benefit.**

Since the recommendations in this section do not constitute a professional development program, it is not necessary to distribute through the state Departments of Education. The Mathematics Teachers Associations alone should be a sufficient means to publicise this product.

5.3 Independent Study Professional Development Course

Our analysis has shown that a face-to-face professional development program, while potentially the most effective type of course, may not be feasible for the NESU to implement immediately. Depending on the resources available to the NESU for this professional development program, some compromises may need to be made. As a result, we have concluded that an alternative program could be developed using another delivery mechanism. While potentially less effective, another mechanism would still result in some improvement among its participants.

If the resources for a face-to-face program are not available, we recommend that the ABS create an electronic professional development program for independent study to be distributed through a compact disk. Compact disks were selected in favour of an online professional development program because many teachers in our focus groups expressed an aversion to the expense of downloading large amounts of content from the Internet. A course delivered through compact disks for independent study was shown to be significantly less educationally effective than a face-to-face program, but it is currently capable of reaching the entire mathematics teacher population in Australia. Furthermore, although the developmental costs of an electronic professional development program are higher than those of a face-to-face program, the recurring costs inherent in distributing a CD are significantly less, which makes an independent study course a comparatively inexpensive national solution for the NESU to implement on its own.

We also recommend that an independent study professional development program distributed through compact disks contain a handbook that outlines solutions to common technological problems that the user may encounter. Some teachers may not have the technological expertise to readily learn through an electronic distribution method, which would severely limit the potential audience of this program unless this concern is addressed. By tailoring an electronic program specifically to those who are not comfortable using it, the number of potential users will increase.

We recommend that a professional development program delivered through compact disks be divided into several modules, organised by topic. Each module should end with examples that stress the real-world relevance of the material. Some modules should be strictly based on the technical aspects of statistics while others should address practices that can be used in the classroom. One of the modules used could be an adaptation of the online lesson plan tutorial recommended in Section 5.3. Our findings indicate that teachers benefit from being able to take time to reflect between concepts during a professional development course. Furthermore, teachers have expressed an aversion to reviewing material that they are already familiar with. To this end, **we**

recommend that a professional development course delivered through compact disks have a menu from which the participants can select what modules they wish to take based on their current knowledge level. This technique also allows the users to proceed at their own pace, which increases the likelihood that the participants will absorb the knowledge.

5.4 Face-to-face Professional Development Course

Our findings indicated that *face-to-face interaction* is the most effective means of professional development education for teachers. This method can take advantage of a variety of teaching strategies and can be very flexible. As an alternative to an independent study program, **we recommend that the Australian Bureau of Statistics design a face-to-face professional development course if sufficient resources are available.** Personal interaction between instructor and audience allows for the participants to see the enthusiasm of the speaker and can increase the interest of teachers to learn the subject matter.

Experts agreed that a program should never consist of a single session over the course of an entire day; separating the program over multiple days allows the teachers to practice what they have learned and address their questions before the course has been completed. **We recommend that programs range between three and five sessions, depending on the amount of content that is presented, with one to two weeks between each session.** Our results show that teachers are unable to devote several full days to a single professional development course. Furthermore, teachers have stated that longer sessions cause them to lose interest as the day progresses. **Based on these findings, we recommend that the first session last between three and five hours and subsequent sessions last between one and two hours.** By dividing the course in this way, participants are able to complete all but the first day of the course after school hours.

We recommend that the ABS avoid creating a one-day face-to-face professional development program. Our findings have shown that a one-day program, while requiring significantly less resources, results in little or no long-term impact upon its participants. If a face-to-face program over multiple days proves cost-prohibitive, the NESU should choose to implement the independent study program described in Section 5.3.

Distance learning can be utilised to extend the reach of a face-to-face course. Research indicates that, barring technological restrictions, distance learning can be very successful. Furthermore, follow-up discussions with several focus group participants lead us to the assumption that some teachers may be willing to travel a farther distance for a single day program than they would for multiple days. As a result, **we recommend that a face-to-face course present the option for distant learning participation after the first session.** Our analysis shows that rural areas of Australia have the resources to participate in distance learning courses. Those who wish to partake in this option should be required

to remain at the first session for an additional period to be familiarised with the techniques utilised in this particular delivery mechanism.

We recommend that classes have between thirty and fifty participants. Decreasing class size increases the expenses incurred to deliver the course to the same number of people. However, experts have cautioned against simply lecturing to an audience; group work is an effective method of learning because of the interaction between participants. For group work to be effective, large class sizes should be avoided. Larger classes tend to overwhelm the instructor and make it difficult for him or her to interact directly with each group.

The first session of a face-to-face professional development program should include the following elements: an overview of the goals of the program, a summary of middle years statistical theory, and an interactive activity. Because it is important that the participants understand and relate to the purpose of the professional development program, we recommend that the course begin with a presentation of the goals of the program as well as the justification of these goals. Also included in the introduction should be an overview of the statistical methods that the program will include. Without the technical aspects to support them, any practices taught during the course will be ineffective. Lastly, we recommend that the introductory session end by having the participants take part in a hands-on activity that they can recreate in their own classrooms. This activity should be done in groups in order to help the teachers build networks that they can use for collaboration both between sessions and after the course is complete. Finally, our sources recommended that activities should demonstrate practical applications using data that is pertinent to real-world situations so that the participants can fully understand the relevance of the material that they are being taught.

We recommend that subsequent sessions of the course begin with time for feedback from the participants. Allocating time for feedback provides an opportunity for the teachers to report on what they have done in the classroom and how effective they felt it was. By collecting feedback of this kind, the instructor can identify the obstacles that the participants are encountering and attempt to resolve them. We also recommend that these sessions involve the development of lesson plans that the teachers can use in their classrooms. Our findings indicate that, by developing their own lesson plans, teachers are more likely to adopt the techniques involved as their own.

Finally, **we recommend that the last session of a face-to-face professional development program should include an overview of the ABS resources available to participants after the class.** The instructor should solidify the networks that have been built during the course by identifying methods through which the participants can contact each other after the course is completed. Furthermore, a set of supplemental materials, such as a compact disk containing data from the ABS, should be distributed. These materials will aid the participants in developing their own lesson plans. We also recommend that the instructor demonstrate how any technology is used so that any technological resources at the participants' disposal do not intimidate them. This

technology includes but is not limited to supplemental compact disk materials, online ABS resources, and online discussion forums.

Our findings suggest that having a face-to-face interaction is the most effective method of delivery in terms of conveying information to the participants. Unfortunately, since a face-to-face professional development program requires travel expenses, supplies, food, and many other recurring expenses, the cost associated with this method is very high. As a result, a face-to-face delivery on a national scale may not be currently feasible for the National Education Service Unit to implement.

To address this problem, we recommend that the NESU first pilot this program in the Australian Capitol Territory (ACT) and deliver this program in conjunction with the ACT Department of Education. Our findings regarding the ACT indicate that their Department of Education is both willing and well suited to deliver a face-to-face program designed by the ABS. Since the ACT is relatively small, we can target the entire region to test the effectiveness of the program. Also, the ACT has venues the ABS can utilise which will decrease the cost involved. This implementation of the course would serve to assess the program for future endeavours and create a precedent for the development of strong working relationships between the NESU and state Departments of Education.

If the NESU chooses to develop a face-to-face program on a national scale based on the results of this pilot, it will need outside assistance. **We recommend that the ABS choose between one of the two following options for distribution of a national face-to-face professional development course: collaboration with the state Departments of Education, or liaising with branches of the ABS outside of Victoria.** Through collaboration, the recurring costs incurred upon the NESU will be reduced.

The first option is to collaborate with the state Departments of Education in the same way that the pilot program was implemented. The NESU should develop working relationships with the departments to jointly deliver a face-to-face course. This method could attract participants from each state or territory because the program would be tailored to their specific curricular needs. Furthermore, the recurring costs of delivery would be partially defrayed by Department of Education resources.

The second option is to work in conjunction with the other branches of the ABS. The NESU could identify an ABS staff member to serve as a liaison in each state and territory in order to facilitate the delivery of a professional development program in that state. If other ABS branches could provide greater support for a statistical literacy professional development program in their own regions, the cost of distributing a face-to-face program would be distributed throughout the Bureau, instead of resting solely on the NESU. Furthermore, travel expenses would be reduced, as professional development instructors could be locally trained. In addition, ABS facilities could be used as venues for the professional development course, which would decrease the total recurring costs.

These recommendations are intended to assist the NESU in completing its mission. Our hope is that the steps outlined in this chapter will foster improvements in the way statistics is taught in the middle years. If the ABS can effectively implement these recommendations, then statistical literacy in Australia could be enhanced, strengthening the development of informed opinions among the Australian population.

References

(1993). *Benchmarks for Science Literacy: Project 2061*. Oxford Press, pg. 209, p209-223.

(2004, July 5) Statistics Show That Exponents In Short Supply. Canberra Times.

The Allen Consulting Group Pty Ltd. Retrieved January 30, 2005, from Allen Consulting
        Web site: http://www.allenconsult.com.au:16080/NIQTASL/

Australian Bureau of Statistics: *Response to Australian Capital Territory Curriculum Review Discussion
        Paper* Dated 28 July 2004

Australian Bureau of Statistics. (2004). *Response to South Australian Certificate of Education Review.*

Australian Government Initiative. *What is it? – About National Literacy and Numeracy
        Week.* Retrieved February 13, 2005, from Web site:
        http://www.literacyandnumeracy.gov.au/2005/about.htm Dated February 11, 2005

Australian Government Quality Teaching Program. (2004).*Quality Teaching Program*.
        Retrieved February 22, 2004 from: Web site: http://www.qualityteaching.dest.gov.au/Content/

Baddeley, Adrian (February 2005) *Review of Statistics in Australian Universities* University of Western
        Australia Submitted to Statistical Society of Australia Inc. pg. 2

Bottomley, John "Reconfiguring Institutional Strategies for Flexible Learning and Delivery" Flexible
        Learning, Human Resource, and Organisational Development: Putting Theory to Work edited by
        Viktor Jakupec and John Garrick Routledge 1999 http://site.ebrary.com/lib/wpi/Doc?id=2002589
        (electronic book) pg. 87-106

Briggs, Ted (2001). Australian Bureau of Statistics: *Corporate Plan*.

Cavanaugh, Cathy. (2002). Distance Education Quality: Success Factors for Resources, Practices, And
        Results. *The Design and Management of Effective Distance Learning Programs*, from:
        http://www.netlibrary.com/Reader

Chance, Beth. (2000). *Components of Statistical Thinking and Implications for Instruction and Assessment.*

Cockcroft, W. H. (1982) *Mathematics Counts: Report of the Committee of Inquiry into
        the Teaching of Mathematics in Schools.*

Cohen, Carol; Gerber, Peter; Handley, Claire; Kronley, Robert; Parry, Megan Profiles of
        Selected Promising Professional Development Initiatives Finance Project Published June 2001,
        ED472665 February 5, 2005 February 5, 2005 pgs. 11-14

The Commission on Applied and Clinical Sociology, Dated Jan. 16, 2005, accessed on
        February 12, 2005 http://www.sociologycommission.org/docs/GLOSSARY.htm

Dean, Carol "They Expect Teachers To Do That? Helping Teachers Explore and Take Ownership of Their
        Profession" Teacher Education and Professional Development with Problem-Based Learning
        Association for Supervision & Curriculum Development edited by Barbara Levin and Jean Pierce
        Association for Supervision and Curriculum Development 2001 pg. 8-23

Department of Education and Training Barwon-South Western Region. (2005) Retrieved
        February 13, 2005, from: http://www.bsw.vic.edu.au/Index.htm

Department of Education: United States of America. (2004). *Improving Teacher Quality State Grants*

Evans, Terry; "Flexible Delivery and Flexible Learning: Developing Flexible Learners" <u>Flexible Learning, Human Resource, and Organisational Development: Putting Theory to Work</u> edited by Viktor Jakupec and John Garrick Routledge 1999 http://site.ebrary.com/lib/wpi/Doc?id=2002589 (electronic book) pg. 211-224

<u>Flexible Learning, Human Resource, and Organisational Development: Putting Theory to Work</u> edited by Viktor Jakupec and John Garrick Routledge 1999 http://site.ebrary.com/lib/wpi/Doc?id=2002589 (electronic book)

Garrick, John; Jakupec, John "Flexible Learning, Work, and Human Resource Development" <u>Flexible Learning, Human Resource, and Organisational Development: Putting Theory to Work</u> edited by Viktor Jakupec and John Garrick Routledge 1999 http://site.ebrary.com/lib/wpi/Doc?id=2002589 (electronic book) pg. 1-10

Giesbrecht, Normand. (1996) Strategies for Developing and Delivering Effective Introductory-Level Statistics and Methodology Courses.

Government of Australia. (1998) *National Library of Australia Archived Page: Australian Education Curriculum Materials*. Retrieved February 13, 2005, from: Web site: http://www.nla.gov.au/policy/ed.html

Government of New South Wales. *Sydney Distance Education High School: Mathematics*. Retrieved February 13, 2005, from: Web site:http://www.ssdec.nsw.edu.au/maths/syllabus_info.html

Government of Queensland. (2005) *Information Technology and Telecommunications (IT&T) in Queensland AU*. Retrieved February 13, 2005, from: Queensland Web site: www.iib.qld.gov.au/itcareers/talk.asp

Government of Tasmania. (2005). *Department of Education Tasmania: Current Initiatives*. Retrieved 20 April 2005, from: Web site: http://www2.education.tas.gov.au/

Government of Western Australia. (2004). *Department of Education and Training: Main*. Retrieved February 13, 2005, from: Web site: http://www.eddept.wa.edu.au/

Government of Victoria. (2004). *Department of Education and Training: School Education*. Retrieved February 13, 2005, from: Web site: http://www.det.vic.gov.au/det/schooled/default.htm

Government of Victoria. (2002&2005) *Victorian Curriculum and Assessment Authority: Mathematics: KLA Structure*. Retrieved February 13, 2005, from: Web site: http://csf.vcaa.vic.edu.au/ma/ksma.htm, http://csf.vcaa.vic.edu.au/ma/lomacd05.htm

Handley, C., Kronley, R. (2001) Framing the Field: Professional Development in Contexts Finance Project. (ED472667, pg. 11.)

Hay, John; "Preface: Flexible Learning and the Work Force" <u>Flexible Learning, Human Resource, and Organisational Development: Putting Theory to Work</u> edited by Viktor Jakupec and John Garrick Routledge 1999 http://site.ebrary.com/lib/wpi/Doc?id=2002589 (electronic book) pg. xiii-xv

Iwanicki, Edward. (1981). Chapter 12: Contract Plans Handbook of Teacher Evaluation Edited by Jason Millman Sage Publications Beverly Hills. p. 203-204.

Lalor West Primary School. *Middle Years of Schooling*. Retrieved February 13, 2005, from: Web site: http://www.lalorwestps.vic.edu.au/middle_years.htm

Levin, Barbara; Pierce, Jean; Dean, Carol; "Frequently Asked Questions About Problem-Based Learning" <u>Energizing Teacher Education and Professional Development with Problem-Based Learning Association for Supervision & Curriculum Development</u> edited by Barbara Levin and Jean Pierce Association for Supervision and Curriculum Development 2001 pg. 121-132

Marilyn Gouthro, www.edu.gov.on.ca/eng/document/reports/numeracy

Massachusetts Department of Education. Retrieved on February 2, 2005, from: Web site: http://www.doe.mass.edu/pd/01guideline/approve.html No Date

McRea, David; Ainsworth, Geoff; Groves, Robin; Rowland, Mike; Zbar, Vic (2001) <u>PD 2001 Australia</u> National Curriculum Services Department of Education, Training, and Youth Affairs pg. 28-79

Nation Education Association. (2002-2005) Retrieved February 22, 2005 from: Web site: http://www.nea.org/teacherquality/index.html

National Institute for Quality Teaching and School Leadership. (2004) Retrieved February 22, 2005 from: Web site: http://www.niqtsl.edu.au/

Partington, Gary. Bernard, Harrison. Godfrey, John. Wyatt, Ken. Department of Education and Training. Government of Western Australia: Why is it important for Aboriginal students to stay on at school and succeed? Factors in the processes of dropping out and pushing out of Aboriginal secondary students. Retrieved February 13, 2005, from: http://www.eddept.wa.edu.au/abled/quality/ ATEA%201997Retention%20Paper.html Dated Nov. 16, 2004

Programme for International Student Assessment (OECD). (2003) *PISA 2003 Assessment Framework - Mathematics, Reading, Science and Problem Solving Knowledge and Skills.* Retrieved February 13, 2005 from: Web site: http://www.pisa.oecd.org/dataoecd/38/51/33707192.pdf

Rumsey, Deborah. (2002) *Statistical Literacy as a Goal for Introductory Statistics Courses.* Retrieved February 13, 2005 from: Web site: www.amstat.org/publications/jse/v10n2/rumsey2.html

Ruse Public School. *Key Learning Area Links*. Retrieved February 13, 2005, from: Web site: http://www.ruse-p.schools.nsw.edu.au/kla.html

Sage, Sara M. "Using Problem-Based Learning to Teach Problem-Based Learning" <u>Energizing Teacher Education and Professional Development with Problem-Based Learning Association for Supervision & Curriculum Development</u> edited by Barbara Levin and Jean Pierce Association for Supervision and Curriculum Development 2001 pg. 87-107

SOFWeb. (2002) *Middle Years of Schooling: Numeracy*. Retrieved February 13, 2005, from: Web site: http://www.sofweb.vic.edu.au/mys/numeracy/index.htm

SOFWeb. (2002) *Middle Years of Schooling: Research Project*.Retrieved February 13, 2005, from: Web site: http://www.sofweb.vic.edu.au/mys/research/MYNRP/index.htm

South Australia Department of Education and Children's Services. (2005) *South Australia Curriculum Standards and Accountability Framework*. Retrieved April 15, 2005, from: Web Site: http://www.sacsa.sa.edu.au/index_fsrc.asp?t=LA

State of Connecticut. (2002). *Connecticut's Professional Development Requirements*. Retrieved January 30, 2005, from http://www.csde.state.ct.us/public/der/t-a/teacher_admin_eval/pd_overview.htm#more

Trewin, Dennis, Fisher, Nicholas, & Wilson, Bruce <u>A Proposal for an Australian Statistics Education System: Overview</u> "Executive Summary" pg. 1-4 Dated 22 Oct. 2003 A

Trewin, Dennis, Fisher, Nicholas, & Wilson, Bruce <u>A Proposal for an Australian Statistics Education System: Development and Implementation of a National Framework for Teaching of Statistics in Australian Schools</u> "Executive Summary" pg. 2-3 Dated 22 Oct. 2003 B

Worcester Polytechnic University. (2003) *WPI Project-based Learning Community: Introductory Overview,* Retrieved April 8,2005 http://www.wpi.edu/Admin/PLC/overview.html

Appendix A: Information on the Australian Bureau of Statistics and the National Education Service Unit

The following appendix gives background information on the sponsor of this project. The National Education Service Unit (NESU) is a section of the Australian Bureau of Statistics (ABS), a government organisation.

Mission Statements and Policy of the ABS and NESU

> "The Australian Bureau of Statistics is Australia's official statistical organisation. We assist and encourage informed decision-making, research and discussion within governments and the community, by providing a high quality, objective and responsive national statistical service." (ABS, 2004)

> "The National Education Services Unit's (NESU) mission is to 'encourage development of statistical literacy in students and teachers and to promote access, understanding and greater use of ABS statistics in the schools sector'. "(Barnett 2004)

The NESU is a section of the ABS that works whose mission to promote the higher goal of the ABS. By working to advance statistical literacy, the NESU is improving the Australian population's ability to have informed decision-making and discussion on information. It is required that all Australians have equal access to public materials created by the ABS. This requirement means that any professional development program assembled by the NESU must conform to all curriculum standards.

History

The ABS developed its foundation slowly over many years. The first step was taken in 1905 with the *Census and Statistics Act 1905*. This act created the position of the Australian Statistician and charged him with collecting statistical data in Australia. Mainly, he was responsible for the *Census of Population and Housing.* In 1975 the *Australian Bureau of Statistics Act* was passed, and the Australian Statistician evolved into the actual Australian Bureau of Statistics. (ABS: Legislative Framework, 2004)

 The ABS was created as an independent agency of the government; the 1975 act defined the functions of the ABS. It also structured the requirements for the appointment and removal of the Australian Statistician. The Australian Statistician was made the head of the Bureau and two deputy statisticians follow him (ABS: Legislative Framework, 2004) Currently, Dennis Trewin is the Australian Statistician. The act also provided for the appointment of the ABS staff and establishment of the Australian Statistics Advisory Council (ABS, 2001).

Organisational Structure

The Australian government funds the ABS. It is split up into six separate divisions consisting of Economic Statistics Group, Population Statistics Group, Technology

Services Division, Information Management and Census Division, Corporate Services Group, and Methodology Division. While division heads are located in the Australian Capital Territory, these divisions are spread out across eight different offices. The divisions of the ABS are: Its offices are located across Australia in: New South Wales, Victoria, Queensland, Western Australia, South Australia, Tasmania, the Northern Territory, and the ACT. The Information Management Division is located in Victoria. A branch of the Information Management is Client Services. The NESU, with whom we will be working, is a section of the Client Services branch. (ABS: Senior Staff)

The structure of the NESU office is as follows:
- Soo Kong - Assistant Director,
- Melissa Webb - Unit Manager,
- Ian Wong - Education Consultant,
- Tim Jones - On-line Production Manager, and
- John King, Georgia Clark and Will Mason - Research Officers.

Our liaison for the project is NESU supervisor, Nicholas Peter.

Appendix B: Samples of Survey and Results

This appendix contains the survey conducted of the professional development course at Worcester Polytechnic Institute and the results. We had a seventy-five percent response rate for our survey.

Teachers' Survey

This survey is being conducted as part of the research for an Interactive Qualifying Project that will take place in Australia in the up-coming spring. The project's goal is to develop a framework for teaching statistics to middle school to early high school mathematics teachers through a professional development program. Your responses, as American mathematics teachers, will give us a preliminary understanding of teachers' opinions on professional development programs. No response is correct or incorrect and all answers will be kept confidential and anonymous.

1. What subject do you teach?
   _____

2. At what level do you teach? (Please check one)
   a. Elementary School____
   b. Middle School____
   c. High School____

3. For how many years have you taught? (Please circle the most correct response)
   a. 1-2 years
   b. 2-5 years
   c. 5-10 years
   d. 10-15 years
   e. 15-20 years
   f. Over 20 years

4. How many professional development programs do you take in a typical school year (June to June)?
   a. 0
   b. 1-2
   c. 3-5
   d. 5-10
   e. Over 10

5. What types of professional development courses have you taken? (Circle all that apply.)
   a. A semester long course that meets once a week
   b. A semester long course that meets more than once a week
   c. A week to two week module
   d. A day to four day long seminar
   e. An Internet based course
   f. A correspondence course
   g. An independent study with assessment
   h. Other_____

6. From the courses you have circled from above please rank according to your preference (1-most preferred, 2-less preferred, etc)
   a. A semester long course that meets once a week_____
   b. A semester long course that meets more than once a week_____
   c. A ten day module_____
   d. A day long seminar_____

e. An Internet based course_____
f. A correspondence course_____
    g. An independent study with assessment_____
    h. Other_____
7. Consider the following motivating factors for professional development programs. Rate them (1-most important, 5-least important) according to importance to you:
    a. Required by school district___
    b. Desire to learn more in area___
    c. Applicable to your field of expertise___
    d. Consequence of an evaluation___
    e. Other_____
8. How did you find out about this professional development program?
    a. Through a supervisor
    b. Through a WPI Outreach program
    c. Through a form of publicity (TV, radio, newspaper)
    d. Other_____
9. a) What was your most productive professional development course

_____
_____

b) Why?

_____
_____
_____
_____
_____

10. a) What was your least worthwhile experience for professional development:

_____
_____

b) Why?
_____
_____
_____
_____
_____
11. Any other comments?

_____
_____
_____
_____
_____
_____

Thank you for your time and your responses. They will be very useful to us for developing an initial guideline for our project.

Responses to Questions:

1.

Subject Taught

- ☐ 14%
- ☐ 16%
- ■ 0%
- ☐ 70%

☐ Math ■ Science ☐ Math & Science ☐ Other

2.

School Level Taught

- ☐ 7%   ■ 7%
- ■ 86%

☐ Elementary School ■ Middle School ☐ High School

3.

Years Taught

15%	1-2 years
28%	2-5 years
15%	5-10 years
8%	10-15 years
5%	15-20 years
29%	Over 20 years

■ 1-2 years ■ 2-5 years ■ 5-10 years ■ 10-15 years ■ 15-20 years ■ Over 20 years

4.

Number of Professional Development Courses Per Year

■ 0 ■ 1-2 programs ■ 3-5 programs ■ 5-10 programs ■ over 10 programs

5.

Types of PD Courses Experienced

Types of Professional Development Programs

■ Semester Long (1/week) ■ Semester Long (>1/week) ■ 1-2 Weeks □ 1-4 Days
■ Internet based ■ Correspondence ■ Independent Study ■ Other

6.

Preference of Courses

Number of Teachers vs Preference (First, Second, Third, Fourth, Fifith)

Legend:
- Semester (1/week)
- Semester (>1/week)
- 1-2 weeks
- 1-4 days
- Internet-based
- Correspondence
- Independent Study
- Other

7.

Motivating Factors for PD

Number of Teachers vs Ranking (First, Second, Third, Fourth, Fifith)

Legend:
- Required by District
- Desire to Learn
- Applicable to Area of Expertise
- Result of Evaluation
- Other

8.

Method for Learning About Courses

Short Answer Summaries:

The following were the short answer responses for the 40 individuals surveyed at Worcester Polytechnic Institute. The questions asked were: What was the most productive professional development course and why, what was the least effective course and why, and a question left for additional comments. Each built represents a individual response.

9. What was your most productive professional development course and why?

- A course for Math that included the use of manipulative. I currently teach 7th grade Special Education and my students greatly benefit from the use of manipulatives.
- The course I am taking now is definitely informative. It's geared specifically towards middle school math teachers too so it's definitely useful information. I like how we can get notes and various handouts online; very accessible. I really need to work on deepening my understanding of some math concepts especially since I was not a math major in college. I do find that some of the math we are working on is way beyond a middle school level but knowing more helps you prepare them for what's ahead. I prefer courses that meet during the school year and for shorter time spans than a one-day, all-day course in math; that would be too overwhelming.
- Tufts Content Institute: Using LoggerPro to teach Force and Motion, because could use immediately in my classroom
- This course, MME 529 at WPI. It has provided a great amount of personal challenge in the field that I teach. The challenge is ongoing, lasting for many weeks. I have more time working with the subject matter than at single day seminars.
- Behavior management, differentiation, or inclusion courses. I have yet to take a pure content related course that has helped me attain math certification or

expanded my ability to teach kids in my 6th grade classroom. They are my most productive professional development courses because they help me reach my goal of attaining or retaining my DOE certifications or allow me to apply my new found skills to the classroom.

- I thoroughly enjoy the courses I've been taking through WPI because I'm extremely busy at all times of the year with coaching sports and running a business in the summer. So by taking the WPI courses and getting the tapes, even though its intended for me to keep up with the rest of the class if I can't then its not a big worry. I can just watch the tapes at a later time. I'm really only taking the courses to better myself as a math teacher; ones that will help to improve the services that I deliver to children. Because I am always looking to improve the way in which I teach and present material to my students

- Skillful teacher, Math in the Middle School (teacher 21). Math in the Middle School is in my subject area.

- Skillful, teacher because I am a first year teacher. I like the math course I'm currently in as well as the new teacher seminar I completed last year. I love math and so an excuse and vehicle to do more is great. The new teacher seminar was packed with great information, tips and tricks to ease my first year.

- WPI Geometry for Middle School last spring 2004 Gave me many new ideas to approach geometry in a non-traditional manner. Hands on based learning works better w/the students.

- A Designing Student Records Course. It provided me with the tools to create a variety of record-keeping forms for tracking student progress, informing parents with reports, and various forms for use within our Team and school.

- University of RI was sponsoring one to two weeks of graduate professional development in mathematics and education each summer. They were six hours per day of intensive training. I enjoyed learning in such a compact and concise way with other educators from around the state. The professors were very in tune to what was important to teachers

- My most productive professional development course was TELL training. TELL stands for English Language Learners. This professional development course was important due to the fact that it provided necessary tools to teach students content while learning English. It offered ideas, sample lessons, and cultural aspects on how students of different backgrounds learn.

- Summer math institute at Mount Holyoke College. Everything is taught very hands-on. The structure of the class allows you to learn true meanings behind concepts you have taught

- Math for underachievers. We have a lot of students this year that are unwilling to do much work at all. This seminar was geared towards real life situations that the students could relate to. It focused on strategies that engaged, taught literacy and writing, along with basic skills, and encouraged students to discuss math from their own perspectives and understanding.

- Courses that are directly related to the specific curriculum that I teach. Based on the fact that MA has a standards-based curriculum, courses that are specific to the content taught at my grade level provide the best learning for my teaching. Based

on the goal that I want to improve my teaching, a course with practical knowledge and applications/ activities /strategies are best.

- Calculus for the Fun of It. The instructor was very good and it was nice to take a higher level math course again.
- Data Analysis. Two parts of several days in the summer and 6 follow up meetings during the school year
- A course on PowerPoint presentations. I possessed limited knowledge of PowerPoint. The two-week course provided me with a working understanding of PowerPoint which has been a useful & regular tool in my classroom.
- I have taken 3 courses at Quincy College which is a 2 year school. I had been a grade two teacher for 10 years and needed a change. I had been a math minor in college in 1968 to 1972 and I wanted to teach math in the middle schools. I felt that I needed to brush up on my math so I took Principles of Albegra, College Albegra and Pre Calculus. I really felt these help me do a better job of teaching alegbra and pre-alegbra plus it was kind of fun for me.
- Study of the significant American Documents. Social studies is my weakest area of expertise. This 10 times 2 hours seminar explained the documents and their history and gave me appropriate methods for introducing and explaining them to 5 grade students.
- A 3 week seminar at UCLA with 110 math secondary math teachers from throughout the US. Because we addressed issues with immediate value and applicablilty to teaching math. When the courses are too general and addresses teaching hints and styles for every teacher in every discipline, they are useless. This course offered by John Goulet is great. More content knowledge and content practice in Mathematics will help to better every math teacher in attendance.
- Still new to teaching so I have not had the opportunity at many courses yet. The district is telling me what I have to take currently.
- 1 week everyday summer course. All material was presented at on time. Working with fellow colleagues aided understanding. Knowing if application was correct and what was needed to make it so was immediate.
- Bridges to Mathematics course offered last summer. I learned more about myself and my peers in that 2 week course - how we teach mathematics for students to understand the concepts, not just rote memory - and it help me to understand the new Everyday Math series my school district just adopted.
- Connected math coaching. Allowed me to work with another teacher to better implement the new math program
- WPI algebra course and weeklong science institute. What I learned at each has had a direct impact on my teaching in terms of being able to reach more of my students instructionally and also the ability of each to improve my subject area knowledge.
- Differentiating Instruction Course. I learned many new techniques/methods for helping the wide variety of students I have in my classes. Teachers were able to share their expertise and ideas.
- My most productive P.D. course was a Connected Math Training for grades 5-8 in my district. It was my responsibility to present and facilitate. Obviously the effort

put forth and the fact that my assistant superintendent "requested" that I take this job on for the district caused my increased productivity.

- WPI Classes in subject area (discrete math) I learned things I never learned in a math class before. I also enjoy learning new ways to teach something.
- McClean Hospital - Awesome Adolescence – day long seminar with a variety of speakers and workshops. Everyone that spoke was very interesting and the day long seminar covered many areas – not just one. This seminar was for my other degree in counseling.
- A course on East Asia (Geography, Social & Political history) It was a subject which I was quite unfamiliar with which made it quite interesting. The course gave many practical applications of the material being taught which will be quite useful.
- A productive professional development course is one that provides me with skills that I can take back to my classroom. I think it is very important to learn more about what you are teaching, but I also find it very practical to get some new materials and hands-on activities that I can take back to my classroom and put to use. I also like to meet with other teachers and bounce ideas and materials off each other. It is very helpful to learn how another teacher is implementing curriculum.
- I am taking an in-house development course now for new teachers that is terrific!! I am taking this because it is required by the district and is a course that all new teachers must take. This class has helped me more than any other course because all the attendees are at the same point and can share and support one another. Our questions and concerns are very similar. Issues that we need help and support in are similar. Several other courses I have taken have been with teachers of various backgrounds, levels of teaching experience, and interest. I have not found these "mixed" development groups to have helped me as much as the group of 26 new teachers I am working with now. Many people who have been teaching for a while are not attending workshops for the same reason I am and I have found many people that have been teaching for a long time are tired, frustrated, and hate their jobs. They aren't fun to be around and are negative.
- I have had several. I like technology for the classroom and motivational strategies. Keeping 7th graders busy and interested is very important.
- MME COURSES KNOWLEDGE, LEVEL, PEERS, TEACHERS
- Graduate course on learning styles. I took this as a six-week course, three hours per week, and prior had taken the condensed version over a two day professional development course through our district. The two day course was mandated as part of the professional development for teachers. The graduate course taken because I want to obtain a master of middle school education, in addition to my other master's degree (and that helps me to make more money)!
- A semester length course in geometry and discrete mathematics, taken via the internet. It was of value to me on several different levels: It reviewed material I had forgotten; it provided new material that hadn't been part of my original math training; but most of all, it suggested approaches to material that might succeed in capturing the hearts and minds of my students.

10. What was your least worthwhile experience for professional development and why?

- A course for math software. It was the second time that I had to sit through the same thing!
- I participated in a district workshop on Singapore Math. It was important to me because this is my first year working with the Singapore curriculum. It was definitely not helpful because it focused on elementary school aged students versus what I would be (am) teaching at the middle school level. Although, it was good to see how the elementary students learn math but it was not useful for helping them when they reach seventh grade. It was a one-day workshop from 8-2; very dull presentation , too much lecture, too much information to absorb in one day, problems did not pertain to my grade level. It was also during the summer and I really don't enjoy taking courses over the summer.
- mentoring program. Poor time of day, scattered
- With very few professional development sessions under my belt, I must say that they have all been worthwhile, though none as challenging as the course at WPI. The problem with single or half day seminars is that the individual is exposed to a great deal of information with little or no time to investigate or research the skills being taught. Though they may be highly motivational, they tend to be less practical than the long term seminars.
- Those courses where I leave feeling I have more knowledge about the topic than the presenter/teacher. I don't find it to be a growth/development experience.
- In the school I used to work at we had to go to pdp workshops that I had a hard time relating to real life situations. The school would bring in speakers from all over the place and their ideas, suggestions often were unrealistic. I'd become discouraged and disengaged because I didn't see the relevance.
- Ones that insult my intelligence and cover things I already know. I don't have time to waste on things I already know
- One day courses that do a "dog and Pony" show and really have no meat to them. Usually it is someone trying to sell you something! There is very little to take back to the classroom with me.
- 2 to 3 hour lecture workshops. Listening to someone talk versus hands-on is very borrowing and gives very little meaning to me.
- Algebra for educators. I do not believe that I'm getting a strong background on the subject since the course seems to be too advanced, and for those with little background in Math is a disadvantage.
- A school sponsored literacy course. It was not geared towards math at all and did not teach me anything that I did not already know.
- I haven't had a bad one yet.
- An all day workshop introducing a new health curriculum. Our school district had a mandatory all day workshop introducing a new health curriculum. The presenters spent the morning reading the Table of Contents and explaining what was in each chapter. I know how to read! The afternoon was somewhat better. I was asked to present a lesson to my peers. Since I had already used the

curriculum for about a month, I just reused one of my lessons. For me, it was a waste of time.

- Courses that include an instructor that sputters out information without practical applications. Or ones that promise lots in the brochure and don't follow through when it comes time to the actual course. These situations are a waste of my time and money. Nowadays, because of lots of funding cuts, monies are no longer available to pay for outside professional development opportunities. Therefore, teachers must pay for these themselves. It is important that courses be very worthwhile
- One day conferences but I still sign up for them. Not enough content or opportunity to consider implementation strategies.
- We had a chiropractic come to one of our 1to 4:30 meeting to talk to us about stress. He handed out his business card and was just trying to drum up business for himself.
- A Reading workshop. Although there were some useful points that could be applied to Math, I felt that my time could have been better spent.
- General courses offered for every teacher. It does not/cannot offer the specifics. You are in a classroom with English, cooking, gym, music, Social Studies etc teachers. Everything discussed is vague, with no direct uses in my teaching, this is a waste of time.
- Topic outside area of interest. Mandated by district. Presenters were insecure and treated all as if they were children. I distinctly remember being very angry and rude to one presenter; I'd been to too many of these to put up with their Bulls**t.
- skillful teacher course. I took one very similar in undergraduate study using the same textbook
- A two day training in the WIAT assessment. This assessment appears easier to give than the assessments I currently use; however, my district does not have this assessment available to the special education teachers who now are responsible for the academic testing for initial and re-evaluations in our school district. I really liked the information that this assessment would give on the individual student and it took less time to administer. After the training, I learned that this assessment was not available to teachers. It seemed to be a waste of time and expense for this training.
- "Links", old ideas and concepts, nothing new
- 1/2 day and full day professional development days offered by my district. Too short of a time frame to get anything accomplished, most of the time is spent skimming the surface of our agenda.
- A writing course for teachers. I very rarely used any of what I learned in this course, because it applied to other disciplines and not mine. I was forced to go to this workshop
- My least productive was a 4 day seminar put on by the Crayola Company to make up for lost hours during the Blizzard of 78. This program was nothing more than a sales pitch for 4 long days. Boring, nonproductive.
- One day seminars are pointless. I took a seminar on connected math/ I still don't know what it is. The topic is never taught thoroughly and you don't have time to

really think about things and develop ideas or get questions answered. They are very superficial.

- I hate missing teaching in my classroom in order to work on the curriculum. I feel that someone more knowledgeable should just tell us what to teach. Every time we change the scope or sequence it gets changed the next year anyways. Curriculum days are a waste. We should just copy a school's curriculum that is scoring high on the MCAS. Why try to reinvent the wheel.

- A one day seminar on the new Everyday math program. Material was poorly presented and sporadic. There was nothing you could really grab from the presentation and apply it to your classroom.

- The biggest waste of my time has been a development course that I was required to take about learning how to use the on-line grade book our district uses. Big waste of my time because I already knew how to use it and was told to go basically because there was nothing else I could attend. Our professional development days are split into morning and afternoon sessions. Because I am a new teacher I had to attend the SET I class I mentioned above and there was no other option available to me for the afternoon session.

- I have taken courses that maybe geared towards math, but do not provide me with any new background information or materials that I can put to use in my classroom. They end up being a waste of time. I like when new skills are taught, you are also given tips on how to apply this information to your classroom.

- District. Most do not apply to my curriculum.

- Most Worcester Public School run sessions designed by central administration. Usually poorly planned and structured, often treating teachers paternalistically and arrogant ones.

- Learning about restraining special needs students. At the time I took the class, and at the present I do not come into contact with special needs students that would require restraining.

- Any one day seminar. Material is presented in a rapid-fire condensed way that I find hard to digest and even easier to forget. Many seminars in teaching techniques are presented in this "you-need-to-have-this-in-your-portfolio-on-record" kind of way.

- A course for math software. It was the second time that I had to sit through the same thing!

- I attended a recent D.O.E. MCAS workshop which was of little benefit. The presenters were from schools very dissimilar from ours. They presented ideas which either were not applicable for our situation or were already implemented in our school. Thus we gained no new information, no new ideas, and no applicable strategies for our use.

- Two day course in summer on internet lessons for students. Below my grade level. Not a convenient commute. Last minute registration by the school w/o my input.

11. Any other comments?

- I do enjoy some professional development courses that pertain to what I teach in school. I do not mind traveling as long as the course will be relevant to what I do or plan to do in the future.
- Professional Development Courses are either really good or really pointless (from the ones I've been too already). I think that the best ones I have been to combine content knowledge and real life application in the classroom….a real classroom. Also, Prof Dev courses that provide good handouts; sample lessons, ideas in teaching concepts & classroom activities. I don't need to go home w/copies of data or MCAS results! Give me something I can use!!
- I think that professional development is an important piece to the complicated puzzle that public education has become. Whether a single skill or a vast set of skills are modeled, it is important for all teachers to be exposed to many approaches to teaching other than their own.
- Again, I must say I really do get a lot of useful information that helps me to feel more confident in my classroom from the courses I've taken through WPI. I'm only a second year math teacher even though I've been teaching in other subjects for my other years. It's very much appreciated. Thank you.
- I am enjoying the Algebra distant learning course through W.P.I, I am learning a lot of background in math that I was missing.
- The most helpful courses for teachers are the ones w/new approaches to math w/real world examples
- I am interested in courses that help me teach mathematics better! I want to bring something into the classroom that will improve my students' achievement and make mathematics more accessible to them.
- Any professional development offered to educators should not be presented with the idea we all know what the concepts are about. They should be presented in a way thinking educators know nothing about the concepts, or that they have different learning styles.
- I would have preferred a class on more methodology rather than content. This class really is not helping me become a better math teacher to 6th grade students.
- I would need specific instructions on using a graphing calculator if it is included in the probability course
- I like the idea of PDP, but I think that it should be left up to the individual teacher, as to what courses or workshops will benefit their situation.
- I don't think mandatory workshops are effective. Only a small percent of the people present actually pay attention to what is going on. The rest either don't care or already know the material.
- Our 1to 4:30 meetings do not have enough choices. Teachers from our system teach these courses and many times we have repeats for the same ones over and over and over and over. I thought that the system would go out and hire quality people to help us with professional development rather that we give each other professional development.

- I think that when teachers are required to do something, there is a reluctance to participate or get anything out of it. Very often required by the state or city programs are far too general and for the most part a waste of time.
- We had the "John Collins" writing method put in place through out the district. Everyone was trained; we were paid to take the course work. Use of the course work was part of our yearly evaluation process. It remains the most successful thing done in this district; it has raised scores (even though some admin types would argue their efforts did). Unfortunately, faced with a similar problem in math, admin seems incapable of repeating their past effort,(they let the curriculum coordinator go) and instead want to "band aid" a fix for math; of course this is doomed to failure. IF SOMETHING IS IMPORTANT… PAY PEOPLE TO PUT IT INTO PLACE…"NO MONEY NO SWISS
- I have recently moved from being and elementary teacher to teaching middle school math so I am really interested in professional development that will directly affect the instruction, assessment, and management of my students. I am also interested in those courses, etc. that will help me progress through the various levels of Massachusetts certification.
- Due to budget constraints (we recently were put on probation to lose our accreditation) our school districts was forced to look "inside" for modules for professional development instead of hiring presenters. Our existing PD Council increased its membership to cover all grades and subject areas. We have forged ahead and found interesting, beneficial, strong programs going on in our district and varied staff has rose to the occasion to present and facilitate these modules. We strive to include all staff, educational assistants, nurses, clerical and administrative positions in the modules offered. Feedback is immediate and mistakes are correctly ASAP. The program and offerings work because the target audience realizes this feeds into recertification. The modules are reviewed, surveyed and chosen by the target audience. With ownership came enlightenment.
- The course at WPI is not what I was looking for. It moves way too fast for the amount of time that most of us "elementary" or "special education" teachers have been out of the classroom. We are not math majors who need a quick review. We were looking for topics that might be useful in teaching 11,12 or 13 year olds – not high school students. Most of us just took math methods for our degrees but we always liked math but we are not math experts. I am very good at reaching seventh graders and in understanding the material that they must be competent in. Lately, the state wants younger children to know more and more "high school" level math. It is for this reason I thought I should "brush-up" on my math. Instead I feel even more frustrated because I have given up precious time for a course that is well beyond what I would ever need to teach in a seventh grade classroom. Our professor is a math genius but after speaking to several students we all agree this course is not what we thought it would be. I would never take a class at WPI again.
- I like the class I am taking now at WPI because I find it interesting and challenging but I thought it was going to have more emphasis on how to teach this material.

- I think if you are trying to develop professional development programs they should provide the math skills and curriculum, but should also provide practical ways to implement the skills and curriculum in the classroom.
- Yes. I have noticed that many times the same professional development courses are offered again and again. Although I have only been teaching 2 years, I have spent an additional 5 years working as an aide in my district. In our district we have never had any math department professional development and that is something I would like to see happen in my district. I see LA teachers and SS teachers get additional training and support from administration. Why can't math & science teachers? We always have to seek it out on our own.
- Professional development is as important in teaching as it is any other profession. Parents would not want a doctor who is not up to snuff on current knowledge in his/her field to treat their children. They should demand the same kind of competence in their children's teachers and insure that administrators provide the wherewithal to obtain it.
- I do enjoy some professional development courses that pertain to what I teach in school. I do not mind traveling as long as the course will be relevant to what I do or plan to do in the future.

Appendix C: Focus Group Questions and Summaries

Focus Group Protocol:

Time Frame:
Focus Group Length: 1.5 hours

Introduction (30 minutes)
Delivery (30 minutes)
Content (20 minutes)
Summary (10 minutes)

Information and Schedule:

Introduction:
WPI Team: What is our project? (What we are trying to do)
Facilitator:
- Ice Breakers: Name, teaching experience: math, statistics, and education background
- Sample: The goal of tonight's focus group is to gather knowledge on your perspective of professional development. Since the project is to make recommendations on the most effective and tailored professional development program for teachers, your opinions are crucial.

Delivery:
- Discuss best and worst professional development experiences
- Preferences for professional development program delivery
  - Outline most/least preferable professional development program delivery mechanisms and why
- Make sure it covers: Internet choices, classrooms, compact disks, types of different professional development program
- Collaboration:
  - Networking experiences
  - How do they feel about networking and its impact on a professional development experience?

Content:
- What do teachers need for their classes?
- What do they want for individual development?
  - Would they respond better to a program that goes beyond the necessary levels for the curriculum?
- What type of balance between the two is desired?

Summary
- State conclusions
- Ask teachers if there is any additional information
- Thank them for their time and who would be willing to be contacted in 3 weeks

Focus Group 1:

Summary:
- Statistics is easy to learn, however it is difficult to learn on there own.
- Lack of statistics experience could hamper effectiveness.
- Hard to find interesting real world examples.
- Wants to be able to access ABS data more quickly.
- Teachers have searched for examples on ABS website, but most unable to find information
- Those who have found information state it is difficult to develop lesson plans based on findings
- Some who have successfully used ABS website said it appears to be out of date.
- Statistics needs to be taught in a way so that it can be incorporated into any field, not just math.
- Said that they would only take a professional development course if it was applicable to use with their students.
- Mathematic Associations could help to support/advertise the program.
- They want a face-to-face program
- They enjoy leaving school, they feel to busy with after school work, to take time to study on there own
- A whole day for professional development was much to long
- They preferred when the course was broken up into separate sessions for shorter periods of time. They felt they learned more this way
- Also, they did not like a large group of people attending one course, they felt it became a lecture which was ineffective in conveying information to participants
- Suggestions for a professional development course
  - Teachers should test the program and give recommendations before it becomes a professional development course. Proving that it works.
  - Impassioned and inspired facilitator, they feel if the instructor is passionate about the material presented they will want to learn it.
  - Also, showing how it will benefit kids is important in getting teachers interested
  - They want the instructors to be practicing teacher to facilitate the course.
  - Incorporate across the KLAs.
  - Course should be given during school hours
  - It should be a series of short courses, with breaks in-between each session, allowing the teacher's time to try out what is taught and report back on it.
  - Flexible to teachers needs and learning styles
  - Courses need to be given during the time when statistical based materials are being covered in KLAs
  - Techniques that can be used: Role Reversal, Activities, Hands-on Learning, Networking and support groups.
  - Real data for examples. (Interesting)
  - Have graphs that they can show their students.
  - Content should be related to the current curriculum

- o Content cannot be dry
- o Needs to be presented in a hands on manor, not just lecturing.
- o By having workshops, teachers can design and try out these new techniques to see how effective they are and figure how to use them in the classroom.
- o Whatever is presented should be able to be used in the class immediately
- o They shouldn't have to change there lesson plans to add new materials.
- o Development of lesson plans is very important to teachers
- o Show possible activities and assessment tools
- o Evaluate the program using a web based system
- o Follow-up should take place a while after the course
- o A CD can cater to everyone.
- o Show statistics as a game to make it more fun
- o Use CD as a supplement to face-to-face
  - ▪ After being asked specifically about how a CD could be used in a professional development class.
  - ▪ They find that CD is more reliable to use as a supplement than web.
- o CDs are great if they can be used to develop lesson plans at home, after being shown how to use them during a face to face course
- o If CD isn't user friendly they usually give up instead of working through it

- Dislikes
  - o Do not like surfing the web
    - ▪ Teachers expressed they feel uncomfortable with independent learning
  - o Internet is slow and it crashes a lot
  - o Internet or CD is no substitute for an instructor
  - o Classes based on theory are very boring.
  - o Statistics is viewed as too dry
  - o Teachers stated when working alone, if they get stuck or confused they usually give up instead of working through a problem
  - o Some teachers stated they would not try a CD or web-based applications unless it was recommended to them by a colleague who has already tried it.

Focus Group 2:

Summary:
- Integrate statistics so that it can be taught anywhere. (all KLAs)
- Change how statistics is taught.
- Statistics appears to be to dry and focused on math, show its applications in real world scenarios
- Teachers feel they need a higher understanding than their students
- Can assume that all math teachers have basic statistical knowledge
- Teachers need to be taught more than what they are going to teach there students
- Statistics is too dry, needs to be more interesting
- Some teachers mentioned they tried to use the ABS website to develop a lesson plan but were unsuccessful
- Essential learning is more important than theory based learning, need to provide examples of how to use statistics for solving problems and using stats to assist in other KLAs
- Mathematic Teacher Associations could be helpful in supporting and advertising the program.
- All teachers recommended that a face to face program was the best method of delivery
- They would not choice other methods over face to face.
- Some stated that the Internet wasn't user friendly, and they didn't have experience in using it.
- Most teachers stated that an web-based application or CD would be a great supplement but preferred to learn for an instructor
- Also, because of time constraints, they preferred it be during school hours.
- Suggestions for a professional development course
    - Teachers input on development of content is important
    - Accredited course, having colleagues recommend this program will help teachers decide whether or not to participate in a PD course.
    - Be aware of time constraints, teachers expressed they did not have free time after school for independent learning
    - They wanted to be taken out of school for a face to face program.
    - Prefer face to face programs over any other course
    - Do not like one day courses
    - Spread out the course over time
    - Smaller classes as opposed to large lectures
    - Lecturing is ineffective
    - Have a lot of group work and workshops to work with teaching strategies and developing lesson plans so they can see how they work in the classroom.
    - Teacher and expert combo facilitation, this allows for better internalisation of goals
    - Passions and inspired learning for the instructor is important
    - Match the class to the curriculum, the course needs to be given the same time that the material is being taught to students

- o It needs to be easily integrated into the curriculum
- o Give participants written material or supplemental CD's during the program, so they can develop lesson plans on there own how to use this technology
- o Needs theory, more than just a refresher course. Again, the want to learn more than the level of the students
- o When and how to use teaching strategies, it is important to show teachers not only what to teach, but how to teach it
- o Teaching techniques: networking support, hands-on, internalisation of goals, role reversal, model classroom, essential learning, and collaboration.
- o Use interesting real life examples (current data) helps make statistics interesting
- o Show classroom results. Teachers stated that students were very interested in comparing results such as test scores and seeing how they compared to the rest of the school.
- o Show practical applications and assessment tools to accomplish the last point
- o Constant feedback is important to improve the course.
- o Feedback can be given during the breaks between sessions to improve the program in its current form
- o Feedback can be given after the program culminates to alter the course for new participants.
- From a follow up interview, some teachers stated they are more willing to travel farther for a one day program, then for a multiple days.

Appendix D: Interview Summaries of Professional Development Experts

This appendix consists of the interview summaries for the professional development experts who were not coordinators conducted in Australia and the United States. It is important to note that some coordinators were also professional development experts and they gave us input in both areas.

Interview Protocol for Professional Development Experts:

Questions on Experience
1. What types of professional development programs have you helped create?
2. What delivery mechanisms did you use for those programs and why?
3. What was the rationale behind the development of said programs?

Questions on Resource Requirements:
1. What types of resources were available for the creation of a program?
   - Person-power
   - Technology
2. What was the timeline for creating a professional development program?
   - Is there a minimal timeframe?
   - What types of obstructions were encountered during your program development?

Questions on Results:
1. Of the programs developed, which were the most successful?
   - Why?
2. Are there any particular features of professional development programs that you feel are essential to a program's success?

Cyr, Martha

Cyr was the Director of the Worcester Polytechnic Institute K-12 Outreach Program and an Adjunct Professor in the Mechanical Engineering Department. The following main points were emphasised by her:

- Professional development is one of the most effective means of improving education.
- Teachers are component professionals that are utilising professional development to improve their knowledge.
- Theory and hands-on activities should be used in conjunction for education professional development participants.
- A professional development program should be tailored to the needs of its participants.
- Classroom materials should be created during a professional development course.

Interview Summary:

Cyr is of the personal opinion that professional development is one of the most effective ways to improve education. She has worked with teachers in a variety of professional development settings from semester long courses to intensive two week workshops. Cyr has a general policy she follows for assembling professional development programs. First, the program should be aware that teachers are component professionals. Second, each course should be aware of its audience and be taught at the appropriate level. Material should be taught with theory and hands-on experience. The order does not matter but both components are crucial. Finally, classroom materials should be assembled during the course in order to allow teachers greater ease when incorporating the new material into their classrooms. From her experience, Cyr has found a ten-day workshop to be the most effective professional development program. There can be 20-25 participants and every day should have a similar schedule. Included in each day can be a hands-on activity, the review of theory, and group work in a long-term project. The project can deal with the development of classroom materials. These materials can serve as a final assessment for the program and should be shared with all participants. This way all the participants will have access to many different lesson plans.

Richards, Michael

Richards was a consultant for the Northern Metropolitan Region of Victoria. His experience has mainly been with teaching strategies and he has been involved in middle years mathematics for the past few years.

Summary:
- Only dealt with face-to-face methods of delivery.
- Feels face-to-face is the best method of delivery for a PD course
- When asked about electronic media when distributing data he told us that it needs to be used as a supplement of face-to-face in order to work well.
- Recommends multiple day PD course
- Any program need time between sessions for feedback and time to apply new techniques into the classroom.
- The goal of PD should be to improve long term classroom practices
- Real examples are very helpful in PD courses
- All programs need a review of pedagogical theory.
- Successful programs should include developing a lesson plan as part of the course
- There needs to be a theoretical basis, but teachers prefer practical applications.
- Need administrative support.
- Internalisation of goals is important to a program
- Don't use just one method of presentation because teachers have different learning styles, and different methods of presentation allow for a more flexible program.
- Having a one day lecture is not effective. He stated that there you can't rely on one particular method of presentation, because the teachers will get bored.
- The problem with mathematic teachers is an on going concern with moving away from the traditional practices as opposed to student activity.
- He felt that teachers need to be working more with activities and less with the traditional style of teaching mathematics.
- Statistics is too dry; it needs to be shown with real world applications.
- A teaching strategy that he suggested was "professional learning teams" or "group work" where the teachers in the class work together in order to later support each other outside of the professional development class.
- Peer support is very effective when learning. Also, it can lead to networking.
- This group work is more effective when you have a smaller number of participants.
- Programs should also offer a wide range of teaching styles such as expert in front of the room and participants reflecting through activities, designing course materials in the classroom, and group sharing and brainstorming. In this way you can keep the teachers interested in the program.
- Having teachers recommend this program and teach it is a great way of initialisation of goals.

- He suggested that using only trained teachers as instructors of a professional development course was too narrow of a view and that an expert was needed at some point.
- He also told us that middle year mathematics teachers feel they are too busy to take time out to take a program and that you must be aware of this fact when planning courses.
- He thought that good practices for structuring a professional development course were to involve support from administration, make the course not too far away from your audience, theoretical mixed in, follow-ups after the course, internalisation of goals, and practical classroom

Wong, Ian

Wong was a consultant for the National Education Service Unit. Previously, he was a teacher, professional development designer, and professional development coordinator.

Summary:
- He has worked on many different PD courses for school to statewide level.
- He stated that for educational professional development a support group and networking approach is best.
- He worked on two projects to create professional development programs, one for the Ford Motor Company and one for integrating technology into the classroom for Victoria.
- An educational professional development course had a budget of $700,000 in order to reach 650 teachers. Rough estimates of 300,000 for development and 400,000 for implementation.
- Ian felt that there are certain key aspects that should be included in a professional development course contain hands on experience, perspective and real world relevance, up-to-date program, practical problems, and outside motivation.
- He stated that it is better to take people out of there work environment to eliminate distractions.
- Ian also told us that the larger a program is the more "red tape" that you have to go through, which means that there is more time required for creating one.
- Both of the two programs that Ian helped to develop took a year to create. It is also important to look ahead to see what kind of effect a program might have on teachers, it might not be immediate.
- Ian told us that teachers are under a large amount of pressure and they are required to take many programs that are not always useful and are sometime skeptical of programs because of this.
- When CDs and computer based programs were discussed Ian said that self-teaching can be very useful but people get annoyed with software.
- Teachers are diverse and some of them are not familiar with technology, therefore a program must be allowed to adapt to the users level of knowledge and expertise.
- The Mathematics teachers Association could be useful for networking and contacting people. They also provide teachers with outside reasons for attending professional development.

Appendix E: Interview Summaries of Professional Development Coordinators

This appendix consists of the interview summaries for the professional development coordinators conducted in Australia. It is important to note that some coordinators were also professional development experts. Asterisks denote those who belong in both categories.

Interview Protocol For Professional Development Coordinators:

Questions:
1. How long have you been a professional development coordinator?
2. How did you get the job/role of being a coordinator?
3. Are teachers required to come to you to find programs or can they do it on their own?
4. How would you characterise the nature of professional development in our district?
   - Describe the general level of interest in professional development.
5. Who do you deal with (Find professional development programs for)?
   - Teachers
   - School board
   - Administration
6. When people come to you looking for professional development programs, what would you say motivates them to make the decision that they do?
7. Why are certain professional development programs more sought after?
8. What are some considerations that you make when determining whether or not to recommend a given professional development program?
   - What is the biggest limiting factor?
   - What types of things are "deal breakers"?
9. Given that someone has shown an interest in particular type of professional development program, what criteria makes one program of that type more or less preferable than the other?
10. How do you find out about the different professional development courses?
11. What would you say are the defining characteristics of a successful professional development program?

Coleman, John*

Coleman was the professional development coordinator for the Rockhampton District in Queensland Australia.

Summary:
- He found that the old idea of the traditional one day lecture was useless.
- He has found that teachers who participate in these one day lectures are not able to implement what they have learned. No long term improvements are gained are made.
- Rockhampton's new method of professional development is to send five to ten teachers from the district to a main program so that they are trained to deliver content back to the schools.
    - They go from individual schools to implements the professional development course.
    - Then after the first course ends the teachers work to incorporate the new knowledge into their schools.
    - After a few weeks, the trainers come back to the school to make sure the techniques are being practiced and to assist if there has been any trouble it integrating new knowledge into the classroom.
    - In this way, the program has multiply days to insure the effectiveness of the program
- Locating professional development is done by the school or the district. Sometimes schools will work together in order to arrange professional development.
- Mostly, professional development is organised as a whole school approach. Monthly meetings are held usually consisting of 18-22 people: teachers and principals that discuss and evaluate schools target areas.
- Even if a program does not match these target areas, if it is deemed to be of use it is sent on to the schools.
- The central office sometimes runs programs that the school districts are expected to send representatives to attend.
- Assessment of the programs are done on a school to school basis, the district office does not keep any kind of record. It is expensive to send individual teachers to programs and thus it's difficult to get people trained.
- Electronic media has been used and the district office sometimes pursues it but face-to-face contact is usually included with any CD or website.

Cook, Jennifer*

Cook was the Professional Development Coordinator for the Eastern Metropolitan Region of Victoria and a consultant for the Mathematical Association of Victoria.

Summary:
- Primary schools have different focuses than secondary schools and that can change the perspective on education.
- She created two different professional development programs; both went through the state department and worked on the distribution concept of training the trainer.
- She stated that mathematics is moving away from closed questions, and towards how to use content in real world applications
- She felt that the idea of training the trainer is flawed, because the two professional development courses she tried in this way did not work, mostly because they were done in a lecture style. She felt that one day courses are close to useless because you can't incorporate as many teaching strategies in them.
- She recommends that teachers needed real courses that are hands on and then apply the ideas within their own courses.
- She stated that having a few classes with breaks in between allow the application of techniques, and allow for perfecting said techniques
- It is good for a program to be flexible in order to adapt to teachers needs and learning styles.
- Evaluation according to Jenny is important in order to justify the funds that are being put into the course.
- A good review means you will keep getting funding. Resources necessary for different programs are different depending on the different situations.
- She has worked in a 6 day nation wide program, estimating the total development and recurring cost to be a few million dollars.
- Experts cost around +$1000 a day to hire while teachers are around $300 a day.
- Venues run from $3 – $4000 a day
- Catering usually runs for $20 a head
- A lot of money is needed for a state-wide initiative.
- Programs the run over a long period of time are better because it allows for teachers to learn information better and implement it into the classroom.
- Teachers need to go to real programs where they can interact with each other.
- Using role reversal is very effective in showing how students learn from the teachers
- Model classrooms are key components to teaching strategies
- It is good to have a few instructors and switch different presenters so the participants don't get bored
- Networking should be set up and regulated by whomever is running the PD course
- Jenny also said that it is important to understand the teachers' level of knowledge before you start teaching them. This flexible method will allow the instructor to gauge the audience and target the areas that need improvement

- The what, why and how are very important and should be explained to all the participants. This is crucial if you want the participant to develop an internalisation of goals
- There should also be class participation or "group work" in a professional development course.
- Teachers also need be able to discuss, evaluate, and implement the program information into the classroom quickly and without changing their current lesson plans.
- Supplemental materials that can be used right away should be given to the participants during the professional development program.
- A CD is a great idea to use as a supplement to a face-to-face program as long as it is shown how to be used by an instructor. If there is any new material then the CD needs an explanation, but if its just data there is no explanation required.
- If a CD is too complicated teachers will give up instead of working through it.
- The idea of sharing lesson plans is a very good teaching strategy but not always practiced.
- Chat forums are a great idea, but participants need to be trained (during the face-to-face program) in order to use it effectively.
- In Victoria all teachers are required to have a laptop computer.
- Some teachers are good with technology, others are not. For those who aren't, help needs to be available to them.

Grey, Richard

Grey is the Principle Curriculum Officer for Western Australia as well as a professional development coordinator for the region

Summary:
- When setting up professional development program in Western Australia they create a template that any professional development instructor can present.
- The program is completely scripted.
- This means that the program can have many different instructors and yet all the participants learn the same information.
- So far they have found this method to be extremely effective. In these programs teachers are given time to go back to their classrooms and try out the new ideas that they get and then are able to report back to the course.
- Based on the effectiveness of the "two classes are better than one" method. He feels most successful models he felt took place over time. More specifically, that the course be a multiply day course, with time in-between classes to test out new techniques.
- He also pointed out that the one day lecture style of delivery did not work at all. He felt that this was because teachers need hands on experiences in order to understand the material that is being presented to them.
- Smaller groups allow for more "group work".
- He also felt that some theory was necessary as a basis to any professional development course on statistics.
- Mr. Grey believes that collaboration between teachers is very useful but hard to implement. It is not easy to create networking during a short professional development course. Networking is a good long term goal.
- It is important to implement strategies into real classrooms before the program has culminated.
- This way during the course the teachers can see results of what was learned in the program.
- An effective method for this is to create CDs of the different samples and give it to the teachers.
- Other essential features of a professional development program are relating the course to the current curriculum in order to show teachers how these new techniques they are learning connects to the classroom. Being able to integrate new knowledge into the classroom quickly is very important.
- He stated that teachers in WA are supplied with tools for distance learning.
- He stated that while delivering a PD program can be done electronically, it is most effective to use technology as a supplement to a face-to-face professional development course.
- Electronic tools are a great resource they just require an explanation by an instructor before they are used.
- A program for statistics should be integrated into the other areas of maths and the key learning areas in order to make it more effective.

Hughes, Bruce

Hughes is a member of the Professional Learning Sector of the Australian Capital Territory (ACT) Department of Education.

Summary:
- Each ACT school has its own professional development coordinator.
- ACT has a database on all of their professional development courses and coordinators.
- Department of Education policy is that professional development courses pertain either the curriculum or to key competencies.
- The content of the PD course must be able to relate to real world applications
- He informed us that any professional course given should not focus on Microsoft Excel or other types of technologies. Only PD courses given where based on teaching strategies and practical applications.
- He stated that professional development programs should be integrated into the curriculum and that participants should understand how the program relates to the curriculum.
- He is of the opinion that teachers would like professional development courses to correspond to the portion of curriculum that they are currently teaching.
- Hughes also commented that any professional development course should utilise many types of presentation styles.
- He stated that factors in delivering a professional development program were teachers' time constraints.
- Hughes claims that teachers have a limited amount of time to take professional development; any professional development course needs to be assembled with this claim in mind.
- Also, Hughes stated that teachers should be removed from their normal classrooms and taken to another location for the professional development program.
- The new location keeps the teachers from being worried about outside distractions.
- He suggested that the professional development program give teachers' time to reflect between classes.
- To allow for more time, he recommended a professional development program consist of multiple days.
- He also mentioned that skilled presenters should deliver the information to the class.
- When he was asked about electronic means of delivery he said that it could only be effective when used in conjunction with a face-to-face course.
- In the ACT, each school has to have a professional development coordinator. According to Hughes, they have a database that contains information on all of their professional development courses and coordinators.
- He stated that teachers within the ACT are required to take three days outside of class for professional development and one-day session during class-time.

- The ACT tries to compensate teachers for taking time out to take professional development.
- According to Hughes teachers in the ACT all have access to technology and the Internet.
- He offered to test pilot a program in the ACT
    - The Department of Education has workshops and can provide venues
    - The ACT is very small and can reach all teachers through it with limited difficulty.
    - Since it is small, the Department of Education has close ties to most coordinators and principles which can help in disperse a PD program.

Pirouet, Nathan

Pirouet is the assistant principal and professional development coordinator for the Cowes Primary School in the Gippsland region of Victoria.

Summary:
- Professional development it given in two main areas
  - The entire school is required to take PD based on the schools charter goals sometimes referred to as "Blueprint" or Flagship" skills.
  - Individual teachers are required to take PD based on their areas of weakness
- The school is given a budget for professional development, it is divided into 2 sections
  - One is for charter priorities
  - The other is for individual professional development
- Teachers are required in Victoria to take 3 days of individual professional development
- Victoria schools receive a PD book detailing the professional development courses, from the Department of Education, being offered for the year. All PD courses listed have the same format.
- He receives this book from his cluster coordinator Allison Stuart
- Clusters are organised for the regions so that schools talk to each other and the department of education.
- Also, they receive advertisements for professional development by outside groups, which can be more appealing visually.
- Coordinators view PD offered by the Department of Education as a less risky, more credible form of professional development. Usually PD courses offered by the Department of Education are chosen over all other methods.
- Some teachers look up their own PD they will attend. Nathan stated that most teachers usually participate in programs he recommends to them.
- Face-to-Face is the only kind of professional development in which Cowes participates.
- Cowles has switched from content based professional development to programs based on essential skills.
- He keeps a record of all the professional development courses that teachers have attended. This way, he knows which courses to avoid, and which to recommend to future attendees.
- He also told us that the curriculum is very full and demanding on a teacher's time.
- Nathan checks all the professional development courses that the teachers take to make sure they match up with the curriculum, syllabus or school goals.

Stuart, Allison

She is a cluster organiser and teacher at the Wonthaggi Secondary College in the Gippsland region of Victoria.

Summary:
- Allison had just started working as a cluster organiser; she had previously made professional development courses before assuming her current role.
- She had taught a full day face-to-face professional development course followed by three shorter evening classes.
- She felt this type of course was very effective.
- According to her, in order to have a successful professional development course you need a support structure, or "network", that will aid the teachers in using what they learn in the professional development course.
- She also told us that teachers need some theory but to not overly cover it.
- According to Allison the teachers that attend professional development courses need to develop lesson plans and bring back materials that they use in their classes.
- She also confirmed that she obtained professional development booklets on professional development courses being offered in Victoria from the Department of Education in Victoria and gave them to the members in her cluster.
- She also informs schools about professional development opportunities through the use of e-mails.
- In order to make a professional development course work, you would need to get the teachers interested in what you are teaching them.
- Internalisation of goals would be a good way in which to do this. She also told us that mostly schools know what they need for professional development then go out to find courses that can help them in those particular areas.
- Any professional development course that is given could charge but she suggested that the price never be higher than $100.00.
- She informed us that there should be at max 25 people in a group face-to-face program.
- She also told us that the facilitator of the professional development course should attempt to get feedback from the teachers in order to better the class.

Thorpe, Neil

Thorpe is the Twoomba District Professional Development Coordinator in Queensland.

- Queensland is updating its mathematics syllabus from 1988.
- Teachers in Queensland look for professional development courses based on the current curriculum and syllabus.
- They have 12 professional standards around which they create professional development courses.
- Queensland tried to use compact disks as a way to teach professional development. This program was implemented state-wide. It was decided, after reviewing the CD professional development program, that it was ineffective as a professional development method. Queensland has decided not to use this method of delivery again.
- Found success in using training teachers to teach professional development courses.
- Communication routes through Queensland are straight hierarchal; there is not communication at each of the levels.
- Neil Thorpe has been a professional development coordinator for 10 years.
- According to him principles find programs for the teachers and the district offices provide suggestions for the schools.
- A driving factor is to find programs for teachers related to the current curriculum and syllabus; the content presented needs to be tied in with real life examples and life learning.
- The biggest limiting factor for the teachers is time.
- The teachers have a requirement to take at least 6 days of professional development per year, they get those 6 days off.
- The problem is that it costs the schools money when a teacher goes out to do a professional development course.
- He informed us that Queensland trains district personnel in professional development every year for two to three days. This allows for many instructors of professional development programs to be practicing teachers.
- He suggested that experts who are also practicing teachers are the best way to instruct a PD course
- There are also educator organisations that help to distribute professional development courses.
- There are approximately 20 in the region.
- A side note, He also mentioned that the ABS should adjust their website so the teachers can easily access ABS materials.

Appendix F: Departments of Education Organisation and Contact Information

Each of the territories and states has a different distribution process for professional development courses. All of the states and territories have their own central Department for education. From there, they differ in how the central office is organised and the following subordinate offices. In order to recommend to the Australian Bureau of Statistics utilise the Departments for distributing their professional development program, this Appendix contains information on the organisation of each state or territory and contact information for that region.

The Department of Education and Training for Australian Capital Territory:

Organisation:
The Australian Capital Territory (ACT) is a much smaller region than the other territories and states within Australia and because of this it has more local organisation than the other branches. The ACT's Centre for Teaching and Learning Professional Learning Section assembles its own professional development programs tailored to the educational policy of the Department. The ACT Department does utilise other professional development programs, but mostly the Department creates and distributes their own courses. From the Department, the professional development programs are given to each of the professional development coordinators in the ACT. It takes approval from the Department in order to communicate with principals of the schools in the ACT. Since every school is required to have a professional development coordinator, the coordinators screen the programs. Once the coordinators have reviewed information on the professional development course, they can suggest what programs the teachers should participate in.

Contact Information:
Main Office: (02)-6205-9333

Professional Learning Section
Bruce Hughes
E-mail: bruce.hughes@act.gov.au
Phone: (02)-6205-8824

The Department of Education and Training for New South Wales:
Organisation:
The Department of Education and Training provides a search engine known as the Professional Learning Exchange. This engine's goal is to locate suitable and cost-effective programs for the educators. The Department of Education and Training and the States Offices Directorates provide the professional development programs that are searched by the exchange.

Contact Information:
Main Office: (02)-9561-8000

Regional Development Officers:
Surge Girlune
Phone: (02)-9886-7022

Karina Bettison
Phone: (02)-9886-7020
E-mail: karina.bettison@det.nsw.edu.au

The Northern Territories Department of Education, Employment, and Training:
Organisation:
The Northern Territories organised through a main Department that assembles and distributes a list of possible professional development programs throughout its region. The regions then contain coordinators that send the specific programs on to the schools. It tends to take initiatives from South Australia, as that is the major state located near it.

Contact Information:
Main Office: (08)-8901-4909

Furthers contact:
Liz Pierce
Phone: (08)-8999-5979

The Department of Education and Training for Queensland:
Organisation:
The Department of Education and Training has a branch titled the Learning and Development Branch, whose role is to create and collect the various professional development courses that they wish to utilise in their state. A copy of these programs is then sent to the district offices in Queensland, which there are thirty-four. Each district office has a coordinator who is in charge of distribution of professional development courses to their schools. They deliver what the state has provided to them as well as any independent professional development. The district personnel tend to deal with the principals of each school or a professional development coordinator. These people then screen the programs for the educators in their school.

Contact Information:
Main Office: (07)-3237-0111

Learning and Development Branch
Jenny Gallagher
Phone: (07)-3235-4290

Districts (34 total)
Professional Development Coordinators

Rockhampton District Office:
Phone: (07)-4938-4661
John Coleman: District Coordinator
Phone: (07)-4938-4633

Twoomba District Office:
Phone: (07)-4616-9191
Neill Thorpe: District Coordinator
Phone: (07)-4616-9191

Southern Australia's Department of Education and Children's Services:
Organisation:
The Department of Education and Children's Services has a branch titled Organisation and Professional Development Services. This branch is also known as the Developing People Branch. This section of the government is responsible for professional development programs and distributes the programs to the schools and teachers. It uses the Quality Teaching Programme framework for teacher standards. The Quality Teaching Programme also provides independent professional development programs to the educators.

Contact Information:
Main Office: (08)-8226-1527

Louise Wailblinger:
Phone: (08)-8226-4291

Department of Education Tasmania:
Organisation:
In the Department of Education, the Tasmanian Educational Leaders' Institute is responsible for coordinating, facilitating, and delivering professional development programs to the state's teachers. There are four divisions of the branch that work towards these responsibilities. Tasmania is also divided into six districts with main offices. The district offices are also for providing professional development activities to its teachers, including programs, support networks, and mentoring. Next, there are Principle Education Officers for each of the learning areas and for enterprise education. These officers are responsible for coordinating professional development programs in their area.

Contact Information:
Main Office: 1-300-135-513

Department of Education and Training for Victoria:
Organisation:

The education department in Victoria is titles the Department of Education and Training. In Victoria, the state is divided into regions and those regions are composed of clusters. For example, Melbourne in divided into four regions. The Department complies a booklet on professional development that is then distributed to the schools through the clusters organisers. The cluster coordinator at the local school is then responsible to locate the correct professional development program for his or her educators.

Contact Information:
Main: (03)-9637-2222

Jennifer Cook: Eastern Metropolitan Coordinator
Phone: (03) 9881 0231
Email: cook.jennifer.m@edumail.vic.gov.au

Allison Stuart: Cluster Organiser from Wonthaggi College
Phone: (03)-5672-1344

Western Australia's Department of Education and Training:
Organisation:
The Department of Education and Training collaborates with the Quality Teaching Programme in order to create effective professional development for Western Australia School teachers. The Programme publicises the program as well as supports the teachers in their participation in the program. There are district offices in the different regions of Western Australia that locate and screen professional development programs for the teachers.

Contact Information:
Main Office: (08)-9264-4111

Richard Grey: Professional Development for Government Schools
Phone: (08)-9264-4826

Derrik Hurrell: Professional Development for Independent Schools
Phone: (08)-9244-2788

Kathrin Negus: Professional Development for Catholic Schools
Phone: (08)-9212-9258

Appendix G: Contact Information for the Australian Mathematics Associations

The Mathematical Associations of Australia are professional societies for mathematics educators. These societies work to promote mathematics education, improve collaboration between mathematical teachers, provide professional development opportunities for educators, and to be a voice for education in governmental settings. The following contact information was provided by the national Mathematics Association on their website as contact information for the Mathematical Associations in Australia. The information was not dated but was retrieved on 18 April 2005.

National:
Australian Association of Mathematics Teachers (AAMT)
GPO Box 1729
Adelaide SA 5001
Tel: 08 8363 0288
Fax: 08 8362 9288
E-mail: office@aamt.edu.au
http://www.aamt.edu.au

Territories:

Australian Capital Territory:

Canberra Mathematical Association (CMA)
PO Box 3572
WESTON ACT 2611
http://www.canberramaths.org.au

Northern Territory:

Mathematics Teachers Association of the Northern Territory (MTANT)
PO Box 40202
CASUARINA NT 0811
e-mail: m_t_a_n_t@hotmail.com
http://www.pa.ash.org.au/mtant

States:

New South Wales:

Mathematical Association of New South Wales (MANSW)
PO Box 339
NORTH RYDE NSW 2113
telephone: (02) 9878 1487

facsimile: (02) 9878 1675
e-mail: mansw@math.nsw.edu.au
http://hsc.csu.edu.au/pta/mansw

New England Mathematical Association (NEMA)
Care Department of Mathematics
University of New England
ARMIDALE NSW 2351
http://fehps.une.edu.au/f/r/curric/nema

Newcastle Mathematical Association (NMA)
PO Box Box 226
ADAMSTOWN NSW 2289

Southern Cross Mathematical Association (SCMA)
PO Box 1600
LISMORE NSW 2480
http://www.pa.ash.org.au/scmainc

Queensland:

Queensland Association of Mathematics Teachers (QAMT)
Room 201, S Block,
QUT Kelvin Grove Campus
Victoria Park Road
KELVIN GROVE 4059
e-mail: qamt@uq.net.au
http://www.qamt.org

South Australia:

Mathematical Association of South Australia (MASA)
PO Box 94
STEPNEY SA 5069
telephone: (08) 8362 4332
Facsimile: (08) 8363 9002
e-mail: masamail@internode.on.net
http://www.masa.on.net

Primary Mathematics Association of South Australia (PMASA)
Care Elizabeth Vale Primary School
Rollison Road
ELIZABETH VALE SA 5112
telephone: (08) 8255 1307
facsimile: (08) 8287 1563
e-mail: pma@adelaide.on.net

Tasmania:

Mathematical Association of Tasmania (MAT)
PO Box 313
SANDY BAY TAS 7006

Victoria:

Mathematical Association of Victoria (MAV)
61 Blyth Street
BRUNSWICK VIC 3056
telephone: (03) 9380 2399
facsimile: (03) 9380 8323
e-mail: office@mav.vic.edu.au
http://www.mav.vic.edu.au

Western Australia:

Mathematical Association of Western Australia (MAWA)
PO Box 440
MIRRABOOKA WA 6941
Mirrabooka, WA 6061
telephone: (08) 9345 0388
facsimile: (08) 9345 0488
e-mail: office@mawainc.org.au
http://www.mawainc.org.au