DEVELOPING A STATISTICS WORKSHOP FOR PRE-SERVICE TEACHERS

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1. Statistical Literacy
2. Professional Development
3. Education
Abstract

The goal of this project was to develop a workshop that will encourage pre-service teachers to use statistics in their curricula. Current literature and interviews with practicing teachers, university professors, and members of statistical organizations provided information on methods for teaching statistics, professional development for teachers, Australian curricula and standards for secondary and tertiary institutions, and workshop content. A workshop was developed and trialed with ABS staff. It is recommended that ABS perform a trial workshop with pre-service teachers, develop a business plan for the workshop, and make modifications to the workshop for other audiences.
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Executive Summary

There is a shortage of qualified statisticians and lack of statistical literacy in Australia. One cause of this is that teachers across the curriculum are not using enough statistics in their classrooms. Many organizations including the National Education Services Unit (NESU) of the Australian Bureau of Statistics (ABS) have developed education programs to address this problem, but there are very few statistical resources targeted to pre-service non-technical teachers. NESU has proposed to develop a statistics workshop for pre-service teachers. Students from Worcester Polytechnic Institute gathered information through a literature review and interviews. This information was used to create a workshop for secondary pre-service teachers across the curriculum to encourage them to use statistics in their classrooms.

The literature review helped the project group become familiar with statistical literacy in Australia, appropriate methods to teach statistics, what teachers are required to teach their students, what teachers are required to know, professional development of teachers, and other statistical outreach programs. The literature review also defined what questions could be asked while interviewing education professors, teachers, and members of statistical societies.

The project group conducted 24 interviews to obtain suggestions for the workshop. Among those interviewed were teachers, education professors, and members of statistical organizations. Teachers were helpful in providing specific material that could be included in the workshop as well as giving a general idea of how teachers feel about statistics. Professors were helpful because of their ideas as to how pre-
service teachers should be taught and methods that should be incorporated in the workshop. Members of statistical organizations were helpful by giving suggestions about conducting professional development workshops as well as suggestions about interesting material that could be included in the workshop.

After conducting the interviews, the project group analyzed the results of all the interviews and developed a workshop. The interviews helped the project group understand the target audience, the logistics, as well as the content of the workshop. The target audience was determined to be final year pre-service teachers who plan on teaching years 7-10 and subjects ranging from history, geography, economics, and mathematics. The duration of the workshop was recommended to be between 1.5 and 2 hours such that the workshop could be administered during a pre-service teacher university lecture. The recommended number of participants was around 25.

The workshop was created to target pre-service teachers to motivate them to incorporate data into their lesson plans. Each activity allows the participants to understand the need for data and why they need to have data in their lesson plans. The participants will then get involved and develop their own hypothesis based off of actual questions that they could prove themselves. The workshop then will provide self-help material so they can continue to explore statistical resources after the workshop is completed.

The workshop starts with an activity that shows the importance of statistical literacy in society. This is an icebreaker activity as well as to set up the reason why participating in the workshop is worth their time. The activity teaches the importance
of statistical literacy by using news articles that show different ways in which statistics can be skewed and misleading. The next activity illustrates the importance of statistics in the classroom by having the participants locate data-related terms in the teaching standards for their specific subject. This will help demonstrate that application of statistics exist in many disciplines in many different forms ranging from developing a hypothesis to graphing the data.

The next activity introduces the Problem-Plan-Data-Analysis-Conclusion (PPDAC) cycle. The PPDAC cycle provides participants with an opportunity to learn and work with a simple, proven method that properly uses statistics. This activity will also relate the PPDAC cycle to students. The facilitator demonstrates how to develop a hypothesis and go through each step required to come to a conclusion. There will also be an activity to allow groups of 3 to 5 participants to go through the PPDAC cycle themselves. They use questions from the same data set used for the demonstration. Due to time restrictions and the lack of technology available, each group does not work with actual numbers, but simply focus on the process and what they would do if they had data.

The workshop introduces resources that will assist the pre-service teachers to use statistics in the classroom. Some of these resources include CensusAtSchool, Statpak and Microsoft Excel training. CensusAtSchool is a program that involves secondary students taking an online questionnaire, and then allowing them to access a random sample of the pool of data, making it easy for them to analyze data and form conclusions about things that relate to them. The PPDAC activity uses the data from CensusAtSchool. The participants will also be given another ABS resource that
assists them in using CensusAtSchool data in Excel. Statpak Online allows teachers to access ABS publications organized by discipline.

A trial workshop was conducted at the Australian Bureau of Statistics office. The participants and the team from WPI conducted a SWOT analysis of the workshop. The team used the feedback from the participants to make small improvements to the workshop and give further recommendations for workshop changes.

There are several recommendations that the project group has given for the future development of the workshop. The workshop should focus more on interdisciplinary projects to encourage teachers to use them so that their students would better understand the cross-curriculum nature of statistics. Along with these things, a plan for implementation is needed. This should be in the form a business plan that would include a marketing plan, an operational plan, and a financial plan.

Small changes could be made to the workshop to make it applicable to all states and territories since each has different teaching standards. Also, the workshop could be modified for practicing teachers by changing the standards activity to an activity that explores how the practicing teachers use statistics.

The workshop serves as a solid structure with which to encourage the use of statistics in the classroom. In demonstrating and discussing the importance of statistics in society and in the classroom, three important messages are conveyed to pre-service teachers: statistics is encountered on a regular basis, statistics is necessary to make informed decisions and statistics is a subject that can deepen a student’s
understanding of any discipline. By the conclusion of the workshop, pre-service teachers will understand how statistics applies across their subject and experience a method for introducing statistics into the classroom. Additionally, resources are provided to each pre-service teacher for acquiring further information and help when beginning to apply statistics into the classroom.

The content of the workshop remains generic enough to satisfy the needs of pre-service teachers of Mathematics, Science, and Social Science without any modification. This convenient attribute provides the flexibility needed for scheduling workshops with different universities, allowing any combination of disciplines at varying skill levels to attend.

Though targeted at final year pre-service teachers, the overall structure and content of the workshop has been kept basic enough that, with little modification, the workshop can be adapted to fit the needs of other audiences such as practicing educators, media, and secondary college students. Most importantly, however, the workshop’s adaptability serves as a positive step for increasing statistical literacy throughout Australia.
Nomenclature

**ABS:** Australian Bureau of Statistics  
**AGQTP:** Australian Government Quality Teaching Programme  
**BSNSW:** Board of Studies New South Wales  
**CBCS:** Commonwealth Bureau of Census and Statistics (Succeeded by ABS)  
**CSIRO:** Commonwealth Scientific and Industrial Research Organization (Australian based organization)  
**DEST:** Department of Education, Science and Training (A branch of the Australian Government)  
**K-12:** Kindergarten through 12th grade  
**KLA:** Key Learning Area (Term used to define subject areas in Victoria curricula)  
**Maths:** Mathematics  
**NESU:** National Education Services Unit (Branch within ABS, located in Melbourne)  
**NSF:** National Science Foundation (American based organization)  
**Numeracy:** The ability to understand and work with numbers  
**PoLT:** Principles of Learning and Teaching (Part of Victoria’s education reform initiative)  
**PPDAC:** Problem Plan Data Analysis Conclusion (Step-by-step cycle used for developing and proving arguments through research)  
**Practicing Teachers:** Educators that are currently in service  
**Pre-service Teachers:** Students in universities that are studying to become teachers  
**QSA:** Queensland Studies Authority  
**RSS:** Royal Statistical Society (Based in Great Britain)  
**SCTP:** Standards Council of the Teaching Profession (Australian organization that sets the standards for education degree requirements)  
**Secondary College:** School that includes students from years 7 to 12  
**SOSE:** Studies of Society and Environment (Subject area encompassing social sciences)  
**SWOT:** Strengths Weaknesses Opportunities Threats (Process used to evaluate and improve)  
**VCAA:** Victorian Curriculum Assessment Authority  
**VCE:** Victorian Certificate of Education  
**VELS:** Victorian Essential Learning Standards  
**WPI:** Worcester Polytechnic Institute (American university based in Massachusetts)  
**Years:** Also known as grades, years range from 1 to 12
1 Introduction

Statistics can be seen almost everywhere that numerical data are used: in newspapers, television, advertisements, and scholarly journals just to name a few. To understand most types of data, a general knowledge of statistics is needed. Additionally, most careers demand some degree of statistical literacy. Considering the importance of statistics in society, one might be surprised to find out that there is a shortage of qualified statisticians and a lack of statistical literacy. Australian statisticians, at an important conference in 2002, acknowledged this as a major issue (Trewin 3). Many professional organizations have also recognized this problem. For example, researchers at the Commonwealth Scientific and Industrial Research Organization (CSIRO) recognize the lack of cross-curriculum training in statistics and said that a current major issue in bio-engineering is that the scientists do not have the skills to analyze their data properly (CSIRO).

The Australian Bureau of Statistics (ABS) is a government organization responsible for the collection and distribution of statistics in Australia. The mission of ABS is to “assist and encourage informed decision making, research and discussion within governments and the community, by leading a high quality, objective and responsive national statistical service” (ABS). According to ABS “it is becoming well recognized that statistical literacy is a critical though neglected skill that should be addressed if children are to become more informed members of the community”. In addition to providing national statistics services, ABS also works in the area of statistics education (ABS 2). ABS believes the problem of the shortage of statisticians and the lack of statistical literacy can be addressed in the educational system and states that “encouraging discussion about data and information in the
classroom will foster a deeper understanding and appreciation of statistics later in life” (ABS 3). A branch of ABS called the National Education Services Unit (NESU) deals with improving interest and literacy in statistics through education. To address this problem, NESU provides free resources that target both students and teachers. These resources have only been implemented in a limited number of institutions. For example, only 28% of schools throughout Australia have applied the worldwide CensusAtSchool program within their curriculums (Kong). CensusAtSchool is a program that was adopted by ABS to allow students to access and analyze real statistical data. ABS has determined that teachers of all disciplines need to be more aware of these resources so that they can use them for their lesson plans.

ABS believes that many primary and secondary teachers are not teaching statistics in a way that provokes student interest, and that some are not incorporating statistics into their curriculum at all. To address this problem, ABS plans to reach out more aggressively to pre-service teachers. Worcester Polytechnic Institute (WPI) and ABS have formed a collaborative relationship to assist ABS in this endeavor. Accordingly, the goal of this project is to develop outreach training and materials for pre-service teachers across the curriculum to encourage them to incorporate statistical material into their curricula as their careers progress. Ultimately, the project group developed a workshop to present statistics to pre-service teachers. The workshop goals are to prepare and motivate pre-service teachers to use statistics in their classroom activities. The project group accomplished this by answering the following research questions:

1. What is statistical literacy and why is there a lack of interest in statistics?
2. What are the best methods for teaching statistics?
3. What are the current Australian curriculum standards and how do they relate to statistics?
4. What is the current requirement for an accredited secondary education degree and is statistics included?
5. How does professional development apply to teachers and how can it aid in teaching pre-service teachers?
6. What are other successful statistical outreach programs and how were they successful?

The project group also developed a methodological approach that included the following:

1. Background Research: The project group continued to review the literature, focusing on sources and interviews that were unavailable in the United States.
2. Interviews: The interviews answered many additional questions that the background research doesn’t cover. Some groups that were interviewed are education professors, practicing teachers, and members of statistical organizations. These served as primary sources for the research.
3. Workshop Development: A statistics workshop was planned for pre-service teachers that better prepares them to incorporate statistics into their lesson plans.

If the project meets its goals, then there will be more interest in teaching statistics in classrooms. That success, however, will be seen long after the workshop is implemented in Australia. A continuous analysis of the workshop can potentially allow the workshop to become a very useful resource for improving statistical literacy for future generations in Australia.
2 Background

In this section, the project group reviewed the background information and useful literature that was helpful for the completion of the project. First, a background of the Australian Bureau of Statistics is addressed. This leads into a definition of statistical literacy and its importance. The next topics addressed are the reasons why people aren’t interested in statistics and how to teach statistics to promote interest. Following this, there is a review of Australian curricula and standards, secondary education degree requirements and resources for practicing teachers.

2.1 The Australian Bureau of Statistics

In the early 1900s, the newly drafted Australian Constitution stated that Parliament had the power to make laws based upon information from the census and statistics (Australian Bureau of Statistics 1). The 1905 Census and Statistics Act created the Commonwealth Bureau of Census and Statistics (CBCS) to ensure states received equal treatment by developing national statistics. Throughout its early years, the CBCS had a high dependence on the state statistical bureaus for the collection and dissemination of state census data, creating problems when trying to centralize all the data. It became clear that unification of state statistical offices was needed. In 1956, this unification occurred with the 1956 Statistics Act, making state bureaus a part of the CBCS. In 1975, the Australian Bureau of Statistics Act created the Australian Bureau of Statistics (ABS) in place of the CBCS with a mandate to provide reliable, unified statistics and advice on statistical matters to the Australian government (ABS).
ABS’ mission is to “assist and encourage informed decision making, research and discussion within governments and the community, by leading a high quality, objective and responsive national statistical service” (ABS). However, the bureau’s contributions do not stop at the national and state level. They also offer fee-based consultation services to companies and small businesses that would use surveys as well as certain statistical information as decision-making tools.

Many people are unfamiliar with statistics, making ABS a necessary presence within the community as a source for statistical resources geared towards students and teachers. ABS has determined that the source of this problem is in the Australian educational system. In 1990, ABS established the National Education Services Unit (NESU) to “develop statistical literacy in students and teachers and promote access, understanding and greater use of ABS statistics in the schools sector” (ABS 2). NESU has developed programs such as CensusAtSchool to promote statistical literacy. Nevertheless, Soo Kong, director of NESU, believes that young students may not be receiving sufficient statistical education (Kong). To address this problem ABS proposes a program to work closely with teacher training colleges to promote statistical training among teachers.

ABS has made it clear that they believe there is a lack of statisticians. This lack of professional statisticians has taken a toll within the government and corporate sectors throughout Australia (CSIRO). ABS addressed similar problems in the past through use of resources, programs, and promotional materials, such as CensusAtSchool, in order to encourage statistical literacy among the general population. They also wished to encourage students to pursue statistics as a career. Statistics is still an
unpopular profession, which indicates that the current promotional methods could be improved upon.

The NESU, based in Melbourne, Victoria, is but one statistical sector among many in Australia. ABS employs approximately 3,000 people. It is headquartered in Canberra with regional offices in South Australia, Queensland, Western Australia, and the Northern Territory; each deals with a specific statistical field of interest, as listed in Table 1.

<table>
<thead>
<tr>
<th>State/Territory</th>
<th>Services or Branches</th>
</tr>
</thead>
<tbody>
<tr>
<td>New South Wales</td>
<td>Headquarters</td>
</tr>
<tr>
<td>Victoria</td>
<td>Education services, National Centre for Crime and Justice Statistics, Technology Services, and Corporate Services</td>
</tr>
<tr>
<td>South Australia</td>
<td>Corporate Services Branch, Technology Services Branch, Economic Statistics Branch, Statistical Services Branch, Client Services Branch, National Centre for Culture and Recreation Statistics, and the Rural and Regional Statistics National Centre</td>
</tr>
<tr>
<td>Queensland</td>
<td>Transport, tourism, local government, social and demographic statistics, statistical services, household surveys, technology services, client and corporate services, and coordinates census activities</td>
</tr>
<tr>
<td>West Australia</td>
<td>Client services, economic and social statistics, labor employer surveys, innovation and technology services, wages and labor price indexes, corporate surveys, and population survey operations</td>
</tr>
<tr>
<td>Northern Territory</td>
<td>Business services, client and statistical services, the National Centre for Aboriginal and Torres Strait Islander Statistics, demography, and the Census Management Unit</td>
</tr>
</tbody>
</table>

Table 1 - Branches of the Australian Bureau of Statistics

Since ABS is a government organization, the majority of its funding comes from the Australian Government. The Australian Government allocated approximately $45 million AU to the Bureau between 2003 and 2006. In return, ABS contributes expertise by providing national and state governments with statistical information; their assistance does not stop there. They give aid to small businesses, provide consultation on surveys, as well as supply statistical resources for students and staff. Along with these services, the bureau may sell certain statistical information for other
companies to use. All of these ABS organizational facets provide the Bureau with additional funding.

ABS also partners with New Zealand and Canada for mutual aid and assistance to move the field of statistics forward. Finally, ABS works with other countries in the Asia-Pacific rim to establish an effective regional statistical system.

### 2.2 Statistical Literacy

When creating a program aimed at improving statistical literacy and interest, it is essential to understand how statistical literacy is defined and how it is important. Statistical literacy can be defined in many different ways. Trewin believes it is “the ability to understand, interpret and evaluate statistical information” (qtd. in ABS, Statistical Literacy 5). The Australian Bureau of Statistics defines statistical literacy using six criteria:

1. Data awareness, including awareness of multiple data sources to compare statistical claims.
2. The ability to understand statistical concepts and terminology, including terms like average and standard deviation.
3. The ability to analyze and interpret statistical information, including organizing data and recognizing patterns or trends.
4. The ability to critically evaluate statistical information, including the knowledge to determine if the methods selected for data analysis were appropriate choices.
5. Recognition of statistical information as contextual, that is, an understanding that statistics are affected by the context in which they are acquired.
6. Communication of statistical findings and understandings, including the ability to discuss statistical information and form conclusions about it (ABS, Statistical Literacy 6-8).

These criteria cover all aspects of statistical literacy that ABS wishes to address.
2.2.1 Importance

Giesbrecht, professor of research methodologies and statistics, claims “statistical literacy is an essential skill in our modern society” (Giesbrecht 4). An informed person should be able to understand and interpret statistics in his/her everyday life, especially in the news or in scholarly articles. Gal recognizes statistical literacy as a “critical, though neglected skill that should be addressed if children are to become more informed members of the community” (qtd. in ABS, Statistical Literacy 2). Begg mentions statistics’ utilitarian value in all functions of life, particularly for interpreting media and for use in future jobs (Begg 6).

Cerrito believes that “numbers are taken for granted in a society that is innumerate” (1). To make intelligent decisions or arguments, people must find, process, and use technical information with the tools of statistics (Cerrito 13). This is especially true considering that people (most notably, the media) can make misleading numerical claims to strengthen an argument. Having skills in statistics can help one evaluate claims and make educated decisions about what to believe (ABS, Statistical Literacy 2).

2.2.2 Lack of Statisticians

Considering the importance of statistics in society, it may be a surprise that there is a lack of statistical literacy and a lack of interest in studying statistics. In addition to a lack of statistical literacy, Dr. David Mitchell, a department head at the Australian Commonwealth Scientific and Research Organization (CSIRO), says “[There is a] low number of people studying statistics…[and] an enormous shortage of statisticians” (qtd. in CSIRO). Trewin also addresses the issue of the lack of
statisticians, mentioning that respected Australian statisticians met in 2002 specifically to discuss the increasing shortage of professional statisticians in Australia (3). Only 186 people received PhDs in mathematics or statistics in 2004 (CSIRO).

Professor Peter Hall of the Mathematical Sciences Institute at Australian National University said, “There are now 40% fewer mathematicians in university than just one decade ago” (qtd. in CSIRO).

2.2.3 Why People Aren’t Interested in Statistics

One might wonder why there is a lack of interest in statistics not only as a career, but also as preparation for work in other fields. There could be many reasons why statistics is not a popular field. One possibility is that it might not be introduced to students early enough. Trewin mentions that to improve student interest in statistics, they must become engaged early in primary and secondary institutions (4). The Australia Bureau of Statistics agrees that statistical skills need to be addressed during earlier school years (ABS, Statistical Literacy 1).

Many students who start to learn statistics may have pre-conceived notions about it being a difficult or tedious subject. According to Nooriafshar, 31% of high school students don’t enjoy statistics because they view it as a subject that is hard to understand (5). Mittag reported that some students describe statistics as their most difficult course and many fear it (Giesbrecht 6). Also, some students may feel that it is boring. Kettenring wrote that statistics needs an image reconstruction and that many people view statistics as a “dull and impenetrable” subject (1). Teaching statistics in a way that is enjoyable for students may help combat these notions.
Some students feel that statistics is not important and therefore are less likely to be interested in learning it. On the contrary, statistics is very important in many different ways. Statistics must be understood by the students and the public as being “essential for the proper running of government, central to decision making in industry, and a core component of modern curricula at all levels of education” (Kettenring). Holmes agrees and notes that children should learn to appreciate the scope of statistics and the role of statistics in society (10). Nooriafshar found that only 17% of high school students feel that statistics will be needed for their future education or work (see Figure 1)(3). Considering the highly technical society we live in today, this is likely a falsehood because most school subjects incorporate statistics in some way. Also, researchers in all fields utilize statistical data to support their findings. Nooriafshar additionally points out that there should be a concerted effort to convey the importance of statistics to students and the significant role statistics will likely have in their professional activities (11).

Figure 1 - Students' perception of future encounters with statistics (Nooriafshar 4)

The cause of a lack of interest in statistics however, cannot be placed on the students alone. Research has shown that of all the elements that affect student-learning outcomes, the quality of teaching is the most important (Calnin, 4). In a study of 34 pre-service and practicing teachers, Begg and Edwards found that when asked
whether or not they felt statistics was important, the teachers explained that it had a meaningful place in society (Begg Edwards, 2). However, even though teachers may want to convey the meaningful application of statistics in the classroom, the Royal Statistical Society (RSS) believes that teachers have had an inadequate amount of formal statistical training. They state that mathematics courses in universities do not always cover statistics and therefore most teachers are not properly qualified to teach it (Lord Broers, 211).

2.3 How to Teach Statistics

The project goal is to create a workshop that demonstrates statistical teaching methods that pre-service teachers can use in their classrooms in the future. These methods must be effective in arousing student interest.

Statistics curriculum is often presented as pure mathematics and teachers often rely on unimaginative, traditional pedagogical methods (Giesbrecht 7). A boring lesson could create negative feelings towards the discipline. Paas quotes studies that suggest that in formal sciences, such as mathematics, traditional instructional methods, such as lectures, are not effective (Giesbrecht 16). Thomas and Moore claim “there is always a risk that teachers will place too much emphasis on arithmetical processes. Undue attention to mechanical calculation can cause teachers and students alike to lose sight of the inferential side of statistics, the drawing of conclusions and the making of decisions” (1). Bissell agrees, “a non-mathematical approach should be used, especially in the early stages” (1).

Statistics should be presented in a welcoming, rather than intimidating manner. Giesbrecht believes that “educators need to design and deliver statistics instruction so
as to counter anxieties and facilitate learning in concrete experimental ways” (3). Mills states that some studies show students’ attitudes toward statistics can be improved by using “innovative teaching and learning strategies [that utilize] technology in the classroom or hands-on constructivist-type activities” (3). Giesbrecht agrees that computers can be particularly helpful for teaching statistics because they help students visualize the concepts they are learning and that hands-on learning and student research activities are useful methods of teaching statistics (21)(1). Also, using anecdotes or analogies in statistics courses can add an additional humorous spark to the material (Nooriafshar 9). To combat fear or anxiety in statistics courses, teachers should implement things such as retests and open-book exams. Friedman found that 92% of all retake exams result in higher grades, with an average increase of 17 points (Giesbrecht 21).

Showing the importance of statistics in society may make students more interested in learning it. Holmes believes that in order to connect statistics and society, students must be introduced to three key points. First, students must see how statistics are used in making educated decisions. Second, students must be presented with relevant applications of statistics in society. Third, students must also be able to understand real life statistics (Holmes, 457). Bissell agrees by stating “the practical relevance of the subject should be stressed, the students’ interests being guided and developed by the use of examples drawn from everyday situations” (1). Also, Giesbrecht says that failure to connect statistics to the real world causes students to perceive statistics as irrelevant (7). Most people can likely agree with the fact that it is much more fun to learn concepts in a way that relates to them. To further stress its importance in
analyzing data, statistics should often be applied to other subjects such as natural science, geography, and history (Holmes 441).

Some teachers may argue that students will not be able to grasp statistical concepts at an early age, and therefore these teachers will not implement statistics into their curriculum. However, Holmes provides proof that primary school students can learn and enjoy statistics (443). Some successful primary school programs mentioned were Edith Biggs methods and the Nuffield Mathematics Project (Holmes 442). Additionally, Hiltion, Grimshaw and Anderson show different methods for implementing statistics into preschool curriculum.

### 2.4 Australian Curricula and Standards

It is important that the statistics workshop created for Australian pre-service teachers is easily modified for the differences in curricula and Key Learning Areas (KLAs) across the various states and territories. Therefore, it is important to know how these states and territories define their education standards. Also, evaluating standards in areas other than mathematics and statistics will help identify how statistics can be used to meet cross-curriculum standards.

#### 2.4.1 Key Learning Areas

States in Australia often classify their curriculum and standards into Key Learning Areas (KLAs). Some of these KLAs include mathematics, geography, economics, history, English, the arts, and science. In all states and territories, most KLAs require the use of statistics in some way, but for demonstration purposes, the following sections will only go over a few. States such as Victoria, New South Wales and Queensland clearly define the key topics that students need to be familiar with in each
KLA. This project focuses on students in years 7-10 (sometimes referred to as levels 5 and 6).

2.4.2 Mathematics

According to the Victorian Essential Learning Standards (VELS), students at level 5 (years 7 and 8) must do the following to meet the standards for statistics-related mathematics:

1. Estimate the accuracy of measurements and give suitable lower and upper bounds for measurement values.
2. Investigate the theoretical probability of outcomes in simple multiple event trials with the use of tree diagrams for example.
3. Estimate probability using computer simulations involving the generation of random numbers.
4. Take samples to make inferences and predictions about a population, organize, tabulate, and present the data in a graphical format such as dot plots, stem and leaf plots, column graphs, bar charts and histograms.
5. Calculate the mean, median, mode, and range of the data. (VELS, Discipline-based Learning Strand: Mathematics 29-30)

The New South Wales Board of Studies and the Queensland Studies Authority (QSA) have very similar standards at this level (BSNSW, 74-6; QSA, 59). The NSW also adds a student’s ability to “use the inter-quartile range and standard deviation to analyze data” (BSNSW, 22). Also, the QSA adds the students’ ability to determine “fair, unfair and biased judgments”, and “extrapolations from simplified explorations”(59). The QSA standards also require students’ familiarity with standard deviation and graphical shape of data (61).

At level 6 (years 9 and 10) VELS adds the following statistical standards that students should be able to do:

1. Estimate probabilities based on data such as experiments, surveys, samples, and simulations and justify subjective probabilities in familiar situations.
2. For combination of events, list event spaces by lists, grids, tree diagrams, Venn diagrams and karnaugh maps (two-way tables).
3. Comprehend the difference between population and sample.
4. Generate data using surveys, experiments and sampling procedures.
5. Calculate summary statistics such as spread and finding a line of best fit with a scatterplot.
6. Make predictions for variables with strong associations. (VELS, Discipline-based Learning Strand: Mathematics 35-6)

The Board of Studies New South Wales and the QSA have similar standards at this level as well (BSNSW, 74-6)(QSA, 59). The Board of Studies New South Wales additionally adds certain ways in which students should learn to apply their statistical strategies. Some of these included recognition and evaluation of probability statements in the media, likelihood of winning the lottery, games for fairness, common misconceptions in probability such as flipping a coin and getting four heads in a row will not increase the probability of getting tails on the next flip, and the use of probability by governments and companies (BSNSW, 76). See Appendix G: VELS Level 5 Mathematics.

**2.4.3 Social Science**

The use of statistics in social science curricula will help teachers meet the standards defined by the Key Learning Areas. Some KLAs where statistics can be used are History, Geography and Economics.

**2.4.3.1 Geography**

The Victorian Essential Learning Standards for the Geography KLA says “students [should] identify and collect information from… statistical data… and record and represent data in different types of maps, graphs, tables, sketches, diagrams and photographs” (VELS, Geography 14). This shows that some knowledge of statistics is essential to reach a portion of the Geography standards. Also, the Board of
Standards NSW states that students should be able to “construct, read and interpret maps and analyze statistical evidence and construct tables and graphs” (BSNSW, Geography 15). They also add that graphs and statistics should be used to describe trends in Australia’s demographic characteristics (BSNSW, Geography 39). The Board of Standards New South Wales additionally states, “mathematical ideas and techniques is a key competency for geography” (BSNSW, Geography 15). See Appendix H: VELS Level 5 Geography Standards.

2.4.3.2 Economics

VELS states students should be able to “develop an ability to identify, collect and process data…and to interpret tables, charts and graphs displaying economic data” (VELS, Economics 15). The collecting and processing of data are directly related to statistics. The Board of Standards New South Wales agrees that students should use “databases to gather statistics and other information [and] spreadsheets to record and present information” (BSNSW, Commerce 15). See Appendix I: VELS Level 5 Economics Standards.

2.4.3.3 History

The Board of Standards New South Wales states that numeracy is necessary for successfully understanding concepts in history and that history involves the “construction and interpretation of time lines, graphs and other statistical data” (BSNSW, History 20). The Queensland standards agree about statistics’ importance in history stating that students should “use… statistical data to express predictions about the impact of change on environments” (QSCC, 21). See Appendix J: VELS Level 5 History Standards.
2.4.4 Science

In VELS, the Science KLA has many terms and phrases that relate to statistics. Level 5 Science students must be able to “use basic sampling procedures”. Sampling directly relates to statistics (VELS, Science 16). They must also “develop confidence in justifying…the type of data collected” (17). In addition to this, they must “present data in appropriate spreadsheet and graphical form” (17). Other states and territories have similar standards. See Appendix K: VELS Level 5 Science Standards.

2.5 Statistical Experience of Pre-service Teachers

To obtain a sense of the amount of experience that pre-service teachers have with statistics, it was necessary to review the standards for pre-service teacher education courses in Victoria. Prescribed by the Standards Council of the Teaching Profession (SCTP), these standards provide “…guidance for the content, scope and outcomes expected of pre-service teacher education courses” (SCTP, 1). Among pre-service secondary teachers, the guidelines state that a sufficient amount of knowledge must be gained to teach in at least two disciplines; one at the Victorian Certificate of Education (VCE) level (years 11 to 12) and the other for teaching years 7 to 10 (SCTP, 6). As a central element to the knowledge that pre-service teachers must have upon completing their education degree, the VCE study designs supplied by the Victorian Curriculum and Assessment Authority (VCAA) in the subject areas of Mathematics, Biology, Chemistry, Physics, Economics, Geography and History were reviewed. The basic concepts contained throughout each study design included analyzing information presented in a public domain, constructing a hypothesis and plan, collecting and evaluating data, and drawing conclusions from a given data set.
that remains consistent with their original hypothesis. See Appendix L: Skills Related to Statistics in VCE Study Designs for a complete list of skills in each study design.

Additionally, the standards state that graduates of pre-service secondary teacher programs must have adequate skills and knowledge in mathematics/numeracy (Victorian Institute of Teaching, 1). To define what the adequate skills in mathematics/numeracy are, the VELS documentation for Mathematics Levels 5 and 6 were used rather than VCE Foundation and General Mathematics. The VELS curriculum, unlike VCE studies, is a predetermined progression “…set at six levels of compulsory schooling” (VCAA 2006). Key statistical concepts contained in Level 5 of Mathematics include organizing, tabulating, and displaying different types of data, representing data in graphical forms such as dot plots, stem and leaf plots, column graphs, bar charts and histograms, and calculating and using central tendency and spread to make conclusions about a given data set (VELS, Discipline-based Learning Strand: Mathematics 30). Also, key statistical concepts contained in Level 6 of Mathematics include collecting data sets and selecting the best means of representing the distribution, central tendency and spread between the sets (VELS, Discipline-based Learning Strand: Mathematics 38).

2.6 Professional Development for Teachers

Before the project group could begin creating a professional development workshop for pre-service teachers, it was necessary to clearly understand the place that professional development has in Australia. This section establishes the need for professional development in the Australian school sector, the aid that currently exists to foster professional development, and the basic elements that define an effective professional development course for teachers.
2.6.1 The Need for Professional Development

Recently it has been found that the knowledge and experience that teachers bring to the classroom has a considerable impact on a student’s learning experience. Consequently, an effective way to increase student learning is through improving the caliber of teaching. Improving the caliber of teaching then, is likely to come from quality professional development (Calnin, 3). Clearly, “professional development plays an essential role in education reform” (US Department of Education, 1).

Additionally, in a report examining four studies of teacher professional development conducted by the Australian Government Quality Teaching Programme (AGQTP) in 2002 to 2003, professional development “…is now recognized as a vital component of policies to enhance the quality of teaching and learning in our schools” (Ingvarson Meiers Beavis, 2). Within the national and state levels of the Australian government however, there exists no requirement for teachers regarding annual participation in professional development courses. The Committee for the Review of Teaching and Teacher Education within the Department of Education, Science and Training (DEST) of the Australian Government recognizes this and states that “professional learning needs to become a central feature of career development—planned, systematic, regular and relevant” (DEST 2006). Before DEST can begin establishing a professional development standard for teachers and schools however, there must be an increase in the demand for professional development programs as well as a generous supply of aid available for the teaching community to realize the benefits of professional development.

2.6.2 Aid for Professional Development

A substantial amount of funding and aid for professional development of teachers
comes from the efforts of the state and national governments. The Victorian State Government identifies the reason behind government involvement as a change in perception of professional development. Teachers have been moved “…from models that position [them] as the receivers of knowledge developed by others” (Victorian Department of Education, 3). The focus of government models is rather progressive in a sense that teachers are encouraged to develop and refine teaching practices through a variety of methods. Testing ideas for classroom activities, reflecting on the outcomes of new activities, and sharing classroom experiences with peers in groups or communities are now viewed as the most effective ways of education reform (Victorian Department of Education, 3).

The efforts in funding professional development reside with the Australian Government Quality Teacher Programme (AGQTP). The AGQTP is the Australian Government’s “…flagship initiative for supporting quality teaching and school leadership” (DEST 2003). Approximately AU$300M was allocated for the program to assist state and territory government and non-government schools in providing professional development for teachers.

The state of Victoria however, has developed their own initiative in assisting schools. The overall program is known as the Blueprint for Government Schools and consists of four parts: Principles of Learning and Teaching P-12, Curriculum Planning Guidelines, Victorian Essential Learning Standards, and Assessment and Reporting. Professional development is addressed in the Principles of Learning and Teaching P-12 (PoLT) initiative. The aim of PoLT is to create a standard method for incorporating diverse learning environments for students and teachers “…while still
allowing flexibility, innovation and local decision making at the school level”
(Victorian Department of Education, 1).

Other government organizations such as CSIRO provide workshops for a variety of
levels of science. An example of a teacher workshop offered in Victoria is the
‘Almost Free Physics’ class designed to show teachers how to motivate students to
discover physics by discussing and experiencing the application of the science. Key
concepts with instructions on developing models that illustrate those concepts are
included in the course. The workshop can cater to a variety of audiences, including
parents, science teachers and other members of the faculty. At a running length of 90
minutes, the cost of the workshop remains quite affordable at $20 AUS per person
with a set up cost of $390 per session (CSIRO, 1).

2.6.3 Creating an Effective Course

Building an effective professional development course for the teaching profession
requires one to consider certain principles and outcomes. According to the United
States Department of Education, there are ten principles that professional
development should strive for. See Table 2 - Principles of Professional Development
(US Department of Education, 1) for those principles.
Professional development:

- Focuses on teachers as central to student learning, yet includes all other members of the school community;
- Focuses on individual, collegial, and organizational improvement;
- Respects and nurtures the intellectual and leadership capacity of teachers, principals, and others in the school community;
- Reflects best available research and practice in teaching, learning, and leadership;
- Enables teachers to develop further expertise in subject content, teaching strategies, uses of technologies, and other essential elements in teaching to high standards;
- Promotes continuous inquiry and improvement embedded in the daily life of schools;
- Is planned collaboratively by those who will participate in and facilitate that development;
- Requires substantial time and other resources;
- Is driven by a coherent long-term plan;
- Is evaluated ultimately on the basis of its impact on teacher effectiveness and student learning; and this assessment guides subsequent professional development efforts.

Table 2 - Principles of Professional Development (US Department of Education, 1)

From these ten principles, the project group has identified three areas of significance to the development of the workshop. They are duration, course content and teacher engagement, and post workshop evaluation.

2.6.3.1 Duration

Workshop duration can be divided into two categories: short-term and long-term. Short-term workshops last less than two days whereas long-term workshops are defined as lasting two days or more (Lewis Lewis, 300). In an effort to understand the effectiveness of long-term workshops versus short-term workshops, the project group reviewed a program known as ChemConnection. This program combines a variety of short and long-term workshops concerned with relating chemistry courses with relevant social issues. The project itself is a combined effort of the ChemLinks...
Coalition, an initiative in chemical education reform funded by the National Science Foundation, and the Modular Chemistry Consortium, a group of 15 colleges and universities focused on reforming the chemistry curriculum. Involved in analyzing the evaluations taken from the workshops, Scott E. Lewis and Jennifer E. Lewis from the Department of Chemistry at the University of South Florida found that the “…workshops lasting two days or more appeared to provide better results than short workshops” (Lewis Lewis 304). In additional studies, most of the negative feedback was directed towards short-term workshops (Choy Chen 43). Clearly, long-term workshops can provide greater effectiveness when compared to short-term workshops, and understanding what to include and how to effectively portray the material in a short-term course can become a daunting task (Franklin 1).

2.6.3.2 Course Content and Teacher Engagement

Some of the most important elements of a workshop depend on the content of the course and the methods used to engage the audience. When creating a professional development workshop for the teaching community, it is important to realize the change that is occurring in the methods of teaching teachers. The new approach encourages teachers to experience material rather than have material forced upon them by others (Victorian Department of Education, 3). In addition to a personal experience with the material, teachers get much more out of an activity that they themselves helped develop. An activity based on their knowledge of what they need to know becomes much more relevant to them and provides the resources necessary for them to grow and develop as teachers (Choy Chen, 14).

Being mindful of teacher input, the project group reviewed a survey conducted from 1994-1996 by Roger Edwards of the University of Waikato that encompassed 22
practicing teachers and 12 pre-service teachers from across New Zealand. In the survey, “when teachers were asked about what they would want in in-service courses on statistics, nearly all said they would want more ideas and activities for use in their classrooms. Only two said they would want further work on statistics itself” (Begg, Edwards 7). Cohen and Hill agree, stating “…professional learning is more likely to improve student learning outcomes if it increases teachers’ understanding of the content they teach… and how to represent and convey that content in meaningful ways” (qtd. in Ingvarson Meiers Beavis, 8). Representing concepts allow teachers to compare what they do now to what is expected of them by education standards. If a connection is made between what students need to learn and methods of developing classroom actives that help meet those needs, teachers become much more engaged (Ingvarson Meiers Beavis, 9). The basis of this style of learning then becomes an exercise in process and application rather than theory.

Understanding the process and application of the content in a workshop however, cannot be contained solely in the workshop setting. Further exploration needs to take place on the teacher’s own time. Fullan believes that providing support for teachers to develop their understanding of the material after the conclusion of the workshop is a vital part of its content (qtd. in Ingvarson Meiers Beavis, 9). Huberman and Miles agree, believing that as teachers begin to integrate the content into their classrooms, the need for some kind of support becomes even greater (qtd. in Ingvarson Meiers Beavis, 9).

2.6.3.3 Post Workshop Evaluation

Evaluations are an excellent and constructive way to receive information about a workshop. Information from evaluations can provide great insight in understanding
which activities came across well and which activities could be improved. Immediate evaluations are commonplace and provide a chance to get instant feedback from every participant on issues encompassing any aspect of the workshop. However, Calnin believes that evaluations should collect more than just the participants’ feedback. Evaluations should focus on what material actually gets through to the participants and how that material influences their teaching and ultimately the students’ learning experience (Calnin, 20). This method of evaluation requires two parts, a short-term portion and a long-term portion.

A good example of a workshop evaluation that consists of short-term and long-term portions can be seen in the RuralNet program. RuralNet is a West Virginia based project funded by the National Science Foundation (NSF). The aim of the project is to show practicing teachers in K-12 science and mathematics courses how to integrate the Internet into the curriculum. The method of evaluation required participating teachers to be surveyed before attending the workshop as well as immediately after taking the workshop to measure progress and effectiveness (Watson, 157). These data were collected and analyzed and then “six years after the teachers completed the workshops and online courses, the [survey], again was mailed to them” (Watson, 157). Surveys conducted in such a manner often identify long-term results of overall effectiveness of the course content and its delivery.
3 Methodology

The project group’s primary goal was to develop a training resource targeted at final year pre-service teachers. The training resource will be available for implementation across all Australian states and territories, making use of one or more of the applicable Key Learning Areas (KLAs). The training resource, which can be modified to target practicing teachers, encourages pre-service teachers in the use of online resources and software tools that can be used to help incorporate statistics into their lesson plans.

The project group chose to present the training resource as a professional development workshop after careful consideration of sponsor recommendations. The focus of the workshop is to show pre-service teachers how to generate and apply interesting lesson plans for teaching important statistical concepts by using example problems in their discipline. The workshop also provides pre-service teachers with a means to incorporate ABS resources into their curricula. In order to achieve these goals, the project group conducted interviews with university professors, practicing teachers, pre-service teachers, and members of various statistical societies and organizations. The information gained from these interviews was used to develop and test a preliminary workshop. Feedback was then collected from the workshop participants and applied to make revisions to the final workshop.

Table 3 shows a timeline of the project tasks. The literature review began during the preparatory phase in the United States and continued through the 2nd week in Australia. During weeks one and two, the project group established interviews and refocused each set of questions to look at aspects of the workshop. Over the course of
weeks one through four, the project group conducted interviews and analyzed the
gathered information. Week one of interviewing was allocated for ABS employees
and university professors whereas the remaining three weeks were utilized for
practicing teachers and members of statistical organizations. Week three was
dedicated to interviewing members that work for statistical societies and practicing
teachers from other countries at the CensusAtSchool International Workshop that
took place at the ABS Melbourne office. Weeks four through six were used to
develop and refine the framework for a sample workshop to be conducted in-house
with ABS staff. In the middle of week six, the workshop experienced its first trial
run. The project group then revised the workshop according to recommendations
made by workshop participants. The final three weeks in Melbourne were spent
analyzing and summarizing the information for the final report and presentation.

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<th>Task</th>
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<td>Worcester 1 2 3 4 5 6 7</td>
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<td>Literature Review</td>
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<td>Plan Workshop</td>
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<td>Develop and Test Workshop</td>
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Table 3 – Timeline of Project

3.1 Literature Review

The project group’s task was to develop “…a generic basic statistical tutorial or
presentation, deliverable in tertiary institutions to final year pre-service teachers”
The project group developed its strategy for the literature review by analyzing this task.

There were certain areas that the project group needed to become familiar with in order to create the workshop. First, it was important to become familiar with the sponsor of the project. This allowed the project group to understand the overall goals that were to be achieved. Also, considering the project has a goal of helping improve statistical literacy, it was important to understand the definition of statistical literacy. The workshop involves teaching statistics. Therefore, it was important to find literature about how to teach statistics. The workshop is targeted at pre-service teachers and therefore had to be consistent with education standards throughout Australia. In view of this, the project group found literature about Australian curricula and standards. The workshop will be educating and motivating pre-service teachers to teach or use statistics. Considering this, it was important to review teachers’ background in statistics and how they view statistics to understand how the workshop could improve these areas. It was also very important to understand professional development of teachers and review other workshops, how they were implemented, and their level of success. Additionally, becoming familiar with other statistics outreach programs was helpful to get ideas for the workshop.

The majority of the literature review was completed in Worcester, Massachusetts. While in Melbourne, attention was paid to revising sections within the paper that needed clarification and to fill gaps in information that was not available in the US. Due to the minimum amount of time that the project group had to create the
workshop, the project group could not spend much additional time on the literature review while in Australia.

3.2 Interviews

Interviews were helpful in collecting information and suggestions for the project group’s workshop. To view the problem from multiple perspectives, the project group interviewed many people within the fields of education and statistics including ABS representatives, professors within education departments, practicing teachers, and members of statistical organizations. Each group provided valuable input for developing the best method and content for the workshop. In the initial stages, the workshop will only be implemented in the Melbourne area, therefore the project group chose to interview at several universities and secondary colleges around Melbourne. Most teacher and university contacts were found through online research. Others were found from referrals.

The interviews had several overall goals. One goal was to explore the reasons why teachers do not always incorporate statistics into the classroom. Also, the project group wanted to examine teaching methods to implement into the workshop for pre-service teachers. Additionally, the project group wanted to determine the ideal characteristics of the workshop. These characteristics include things such as duration, day, time, and location. Finally, the project group asked interviewees if they knew anyone else that might be helpful to the project.

The project group spent the first two weeks preparing for interviews. During this time the project group refined the interview questions based on their previous successes or failures in the interview environment, making sure to tailor the questions to the
interview goals. During the preparation weeks, the project group also established other interview opportunities. While in Worcester and through week four the project group carried out the interviews. The following sections explain the specific information sought from each group of interviewees.

3.2.1 Professors

Education professors teach pre-service teachers and became a necessary source for determining how to present the workshop to the target audience. The professors were asked to provide suggestions on methods to increase teachers’ interest to teach statistics. Also, the project group directly asked them for suggestions about how to conduct a workshop to educate and encourage pre-service teachers to incorporate statistics into their curricula. Their feedback strongly influenced the creation of the workshop. The professors also answered questions concerning the current statistical requirements within the pre-service teacher curriculum and the level of experience with statistics that pre-service teachers have. Interviewing the professors also gave the project group an opportunity to inquire about the professional development requirements that Australian teachers must undergo.

The interviewees were identified through recommendations from the ABS. Other professors were chosen if their research dealt with teacher education. See Appendix A: Interview Questions for Education Professors.

3.2.2 Teachers

The interviews with practicing teachers focused on understanding their firsthand experience with teaching and obtaining suggestions on how to present statistics to pre-service teachers as well as to students from years 7-10. The project group interviewed cross curriculum teachers of years 7-10. These interviews were acquired
through individuals associated with CensusAtSchool. Nick Peter established interview dates and times that were followed up upon.

The project group asked about several key topics. The project group asked the teachers if they incorporated any statistics into their lesson plans. If so, they were asked how successful their methods had been and why they incorporated statistics into their lesson plans. For the teachers that did not teach or incorporate statistics into their curriculum, the project group pursued the reasons why they didn’t, and also what would make them more comfortable with doing so. Also, the project group asked all of the teachers about their suggestions for the workshop. Teachers were also asked how comfortable they were in incorporating technology into the classroom, and whether or not they had the resources at their school to do so. See Appendix B: Interview Questions for Practicing Teachers.

3.2.3 Members of Statistical Organizations

In addition to ABS, the project group sought recommendations for the development of the workshop from representatives of other statistical organizations and societies. Fortunately, many statistical organizations deal with statistics education and other forms of outreach and were able to provide us with relevant information in regards to presenting statistics in the form of a workshop.

During the third week in Australia, the project group attended the ABS CensusAtSchool International Workshop not only to learn how a workshop is run, but also to interview individuals representing statistical societies and education departments from around the world. There are advantages and disadvantages to this opportunistic style of obtaining interviews. It is advantageous because many
qualified experts were available to talk about education for students from years 7 to 10, but it was a biased sample since all the conference attendees were strong supporters and leaders for the international program CensusAtSchool. Instead of asking direct interview questions, the project group provided the interviewees with an outline of the proposed workshop and then discussed on how it could be expanded upon or adjusted.

3.3 Workshops

A workshop is an event that aims to train the participants through an interactive approach. The project group chose to create a workshop based upon the literature the project group had read as well as Professor Martha Cyr’s recommendation that teachers need to experience new methods and curriculum for themselves (Lewis Lewis, 229; Cyr). According to Cornell’s In-Touch program, planning a successful workshop encompasses six main parts including duration, location, content, setup, execution, and post workshop evaluation (Chapin et al.).

These parts were used to establish a guideline to aid the project group in developing a successful workshop. The project group tailored most of the interview questions around the six parts mentioned above in order to extract the necessary information to develop the specifics of the workshop. Pre-service teachers and professors were utilized to understand accessibility of pre-service teachers. This was to find out when and where the workshop should take place. They also provided great insight into what presentation methods work most effectively. Practicing teachers provided valuable information regarding material content and presentation methods as well. Finally, members from statistical organizations gave their input regarding evaluation methods and basic framework concepts. Upon completing the interviews and the
literature review, the project group had a great understanding as to how to develop the workshop.

A trial of the workshop on pre-service teachers couldn’t be conducted, however an in-house trial was conducted with ABS staff to understand what did and did not work regarding timing and material content. A SWOT analysis was conducted and the feedback from the ABS employees proved to be extremely valuable. See Workshop Evaluation section. The project group then analyzed the feedback and adjusted the workshop accordingly. Changes that could not be completed due to time constraints are included in this report as recommendations (see Chapter 6).
4 Workshop Development

The research collected from the background information and interviews significantly aided the project group when developing the workshop. The topics of the research fall into three categories: identifying and characterizing the target audience, determining the workshop logistics, and deciding on the content of the workshop. The project group tailored the workshop content to target pre-service teachers of different disciplines with varying levels of statistical knowledge and experience. The goal of the workshop is to encourage pre-service teachers across the curriculum to implement statistics into their lesson plans. The 24 interviews conducted were very helpful for reaching this goal. The interviews consisted of seven (7) education professors, twelve (12) practicing teachers and five (5) members of statistical organizations. See Appendix C: Interview Notes for a summary of each interview transcription.

4.1 Target Audience

The first task in developing the workshop required the project group to clearly identify the target audience of pre-service teachers that would attend. Comments from professors and lecturers provided the project group with valuable insight regarding the composition of the pre-service teacher curriculum. Furthermore, the interviews and background research helped refine the project group’s understanding of the experience that pre-service teachers may have with statistics and what concepts should be included in the workshop lessons.

In interviews with Mara Rebellato, a former teacher consultant for ABS, and Anita Forsyth, a Senior Lecturer at Monash University, both expressed that administering
the workshop to final year students as they begin to experience secondary curriculum development would be desirable. Forsyth went on to add that providing a curriculum development workshop would be very beneficial for reinforcing the knowledge gained from a secondary classroom experience. However, Susie Groves, an Associate Professor of Education at Deakin University, stated that lecturers and final year students have hectic schedules, believing that finding space for a workshop during the year would prove to be difficult. Groves added that directing the workshop towards second or third year students would be much more desirable due to the flexibility in scheduling courses during those years.

The project group ultimately chose to target final year pre-service teachers. In addition to preliminary recommendations from ABS that focused on final year students, the project group found from the interviews that integrating the workshop into final year schedules would parallel and complement classroom experiences. The knowledge gained during the pre-service teacher classroom experiences in the secondary school sector could prove to be very beneficial in the workshop setting. The content within the workshop however, remains fundamental enough to be placed at any point in the last half of a pre-service teacher curriculum to accommodate universities with varying schedules.

In addition to recommendations from ABS, Rosemary Callingham, a Senior Lecturer within the School of Education at the University of New England, and Jane Watson, a Professor of Mathematics Education at the University of Tasmania, both believed that Mathematics, Science, and Studies of Society and Environment (SOSE) were logical subjects for the workshop to target. Rebellato provided a similar response, stating
that Mathematics, Science, English, Social Studies, and Health could benefit from a workshop such as this. Overall, the majority of the interviewees indicated that encompassing the disciplines of Mathematics, Science, and SOSE within the workshop material would positively impact the secondary school sector. Therefore the project group determined that the workshop should initially target the disciplines of mathematics, science, and SOSE.

Regarding the statistics requirements for pre-service teachers, Groves indicated that there were no requirements in order to be a secondary teacher. Secondary teachers are only supposed to have taken some recognizable math course. Forsyth also indicated that there is an uneven level of statistical knowledge among pre-service teachers and that a lack of confidence with statistics may result. She believes this might be due in part to a bad experience or lack of exposure to the subject.

To understand how much statistical knowledge can be assumed, the project group used the information gathered in Section 2.5 regarding the experience that pre-service teachers have with statistics. The base-level assumption from this research indicates that a pre-service secondary teacher must understand the concepts contained in their subject’s VCE study design and have a general knowledge of mathematics/numeracy. In order to define what a general knowledge of mathematics/numeracy entails, the project group has used the skills expressed in VELS Mathematics Levels 5 and 6. After summarizing the skills relating to statistics in VELS Mathematics, Biology, Chemistry, Physics, Economics, Geography, and History, the project group has concluded that the majority of pre-service teachers will be able to:

- Organize, tabulate, and display categorical and numerical data.
- Represent data in graphical forms such as dot plots, stem and leaf plots, column graphs, bar charts and histograms.
• Calculate and use central tendency (mean, media and mode) and range to make conclusions about a given data set.
• Select the best means of representing the distribution, central tendency and range.
• Construct a hypothesis and plan.
• Collect and evaluate data.
• Draw conclusions from a given data set that remains consistent with their original hypothesis.

4.2 Logistics

The next part of developing the workshop required the project group to define its duration and an effective location to administer it. Although the literature review found that long-term workshops are more effective, interviewees made it sound less realistic. After speaking with numerous professors and affiliates of statistical organizations, the majority of them indicated that running the workshop for 1.5 to 2 hours would be most beneficial and realistic for the pre-service teacher audience.

Keeping in mind the busy schedule of pre-service teachers, the project group further reviewed the interviews with professors and found that introducing the workshop in a lecture setting would be the most effective way of disseminating it to as many pre-service teachers as possible. Professor John Gough of Deakin University indicated that with proper lead-time, a workshop of 1.5 to 2 hours could presumably replace a lecture period sometime during the semester. Forsyth echoed Gough, believing that an audience of about 25 participants would be ideal and that this could be achieved by substituting a lecture with the workshop. In addition, Callingham and Watson stated that introducing the workshop halfway through a course would allow time for lecturers to add material into their curriculum afterwards to help reinforce concepts that the workshop conveys. After analyzing the information from the interviews, the project group designed the workshop to last approximately 1.5 to 2 hours. The
duration of the workshop remains convenient enough for pre-service teachers and
their schedules and remains long enough to introduce meaningful content.

4.3 **Workshop Content**

Once the project group understood the goals of the project, the target audience, and
the logistics for the workshop, it was then appropriate to begin developing the
content. The content of the workshop has been separated into three major sections,
each containing specific goals that relate to the overall aim of encouraging pre-service
teachers to utilize statistics in their lesson plans. Refer to Appendix E: Workshop
Facilitator Presentation to view the outline of the workshop.

4.3.1 **Workshop Introduction**

The introduction of the workshop has two main goals:

1. To help pre-service teachers understand the importance of statistical literacy in
   society and among their students
2. To help them develop a clear understanding of how statistics specifically
   applies to their disciplines

4.3.1.1 **Importance in Society**

Callingham, Watson, and Rebellato all indicated that the workshop attendees must
understand the overall importance of statistics in society as well as how it applies to
their discipline. Otherwise, they are less likely to be interested in using statistics in
their lesson plans. Groves indicated that starting a workshop with a question that
connects their everyday life to statistics is often a good way to catch the interest of
pre-service teachers and usually causes them to think about the subject. In the
literature review, Holmes and Giesbrecht also agreed that showing the importance of statistics in society is important.

Regarding activities that could convey the importance of statistics in society, Watson recommended presenting a news article that contained statistics, then asking the pre-service teachers to find the statistical concepts in the article. She also suggested that the workshop could incorporate material from a website she developed called Numeracy in the News (Watson). The website has articles about sports, diet, environment and science, health, politics, and many more common topics in society that contain statistics and provides key questions that could be drawn from each of them. In an interview with practicing mathematics teachers at Vermont Secondary College, Debra Foreman and Veronika Katona both agreed that an activity reviewing misleading statistics such as those in the news would be interesting and help reinforce basic concepts.

Doreen Connor of the Royal Statistical Society also suggested using an activity to illustrate faulty data collection. Instead of a news article however, Connor suggested the use of a survey. She went on to add that the survey should have a few controversial questions that the audience would first answer confidentially, then by a show of hands. The expectation of the activity is that the answers will be different depending of the method of data collection. This illustrates the necessity of interrogating the methods of collecting data and how sampling techniques can affect the outcome of a study. This is especially important because most teachers usually just tell their students what to do instead of encouraging them to ask questions about the data (Callingham, Watson).
For the workshop to be successful, the introduction must capture the audience’s attention. The project group decided that the best way to accomplish this would be through holding a brief brainstorming session in the beginning of the workshop. The brainstorming session, revolving around the question “How does data apply to society?” would serve as an engaging activity for the audience and cause the participants to start thinking about statistics and data. As participants give responses of how data applies to society, the facilitator will write them on a board for the participants to see. The overall outcome of this activity is for the pre-service teachers to make the connection that data spans many aspects of their lives and that they deal with data on a daily basis.

In order to demonstrate how data is portrayed in the media and the importance that statistical literacy plays in interpreting data, the project group used two different news articles from the Numeracy in the News website (Watson). The two activities require the participants to analyze each article, discuss what each participant found, and develop an understanding as to how statistical literacy plays an important role in evaluating data presented in the media.

The first article activity uses the graphs in Figure 2. The graphs are taken from an article found on page 1 of The Australian on Tuesday, March 1995 entitled “Longer Hours and Less Leisure: We’re a Nation of Workaholics” (Dusevic). The project group concentrated solely on the graphs to illustrate the method by which the data are displayed. The objective of the activity is to demonstrate to pre-service teachers that the methods used to display data can drastically affect the message it conveys. Key
points that should arise during the discussion of the article are the issues created from the scaling of each graph and that when placed side-by-side, the message the graphs convey can be misleading. By the end of the discussion, the participants should be somewhat aware that recognizing the correct methods to present data is a very important skill.

![Figure 2 - Graph used in Article Activity 1](image)

The second article that the project group chose was found in the May 7, 1991 edition of The Mercury, a Tasmanian newspaper, entitled “Beware the Pushy Fish-eater” (Boucher). This short article presents a rather interesting argument relating success to eating fish. The article contains very little information about how the study was conducted, providing a great basis for participants to begin questioning the sampling technique of acquiring data. Pre-service teachers should be aware of the ethical implications that arise from representing results in such a manner in society (refer to section 2.2.1). By the end of the discussion, participants should begin to realize that questioning results and sampling methods is an important skill for making educated decisions.
By the end of discussing the importance that data has in society, the participants should become more aware of the presence that data has in their daily lives and also realize that not all of the data in society can be taken at face value and that interpreting and questioning results are important skills. According to the interviews and literature, if the participants understand how statistics is important in society they will be more likely to use it in the classroom.

### 4.3.1.2 Importance in the Classroom

Many interviews and literature suggested including an activity that showed teachers the importance of including statistics in classroom. Groves, Williams, Doig, Lane, McInerney and Glac stated that it is especially important for teachers to realize the cross-curricular nature of statistics. Callingham and Watson recommended using different strategies for presenting the workshop to non-mathematics teachers and to mathematics teachers. The non-mathematics teachers must realize how statistics can be used as a tool to teach their subject and mathematics teachers must understand that data is applicable to other subjects (Groves, Williams, Doig). Additionally, Rebellato said that teachers should realize that what they are supposed to be doing in class directly applies to statistics. Kettenring and Nooriafshar believe that people need to realize that statistics is or will be needed for their professional activities (10)(11).

Some interviewees suggested the idea of explicitly using the teaching standards in the workshop. A good start to understanding that statistics are used in certain subjects is by looking at VELS (Rebellato; Callingham, Watson). Rebellato suggested that participants could see how statistics applies in their standards by having them pick out the key terms in VELS that relate to statistics. To do this there should be a VELS handout that applies to their KLA (Callingham, Watson). Also, the facilitator should
ask the pre-service teachers if they know that there are statistics in VELS before showing them. It was also suggested that the facilitator be prepared to reference the VELS, particularly with how statistics applies to certain subjects (Connor).

After reviewing their interview notes, the project group decided that doing an activity showing the importance of statistics in the classroom would be appropriate to help pre-service teachers realize the cross-curricular nature of statistics and that their subjects directly apply to statistics. VELS was used to do this. The pre-service teachers will receive a handout containing the VELS level 5 (years 7 and 8) requirements for their discipline. The facilitator will ask the participants if they know how VELS applies to their discipline then have them find the data-related terms in their KLA handout. Then the audience will be asked to read off the terms that they found and the facilitator will write down the terms and the disciplines they are found in as shown in Table 4 - Example of VELS Activity. The facilitator will then put an X in every box that applies while trying to group terms together, when possible. This activity lets the pre-service teachers discover the cross-curricular nature of data on their own. If any boxes are left open, the facilitator will ask attendees to try to think of examples of how they may have used the concepts in their experience. Also, the facilitator will ask for specific examples of how the attendees have used the data-related concepts in their discipline.

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Table 4 - Example of VELS Activity
Forsyth suggested that the workshop introduce the problem of teachers not using statistics in the classroom and tell the pre-service teachers why they are at the workshop. The workshop transitions into this directly after the VELS activity. The facilitator will note that even though teachers need to use data in the classroom, some are not including it because they lack confidence. The attendees will then be told how they are about to receive tools that help them effectively deal with data and use data in their lesson plans.

4.3.2 Workshop Body

The body of the workshop has one main goal: to give the audience a tool so that they can properly use statistics in their curricula. The workshop facilitator will do this by showing the participants how to analyze basic data using the PPDAC cycle and then ask the participants to work with their own set of survey questions in groups.

4.3.2.1 The PPDAC Cycle

Callingham, Watson, and Rebellato recommended that the workshop should include the PPDAC cycle (Problem Plan Data Analysis Conclusion cycle). This is the cycle that statisticians are taught in order to be critical of the data that they are analyzing. (Callingham and Watson). The cycle is a great way of creating curriculum because PPDAC could be incorporated into any subject; it can also provide a way to visualize how different KLAs focus on different steps of PPDAC. For example, mathematics would focus on the data and analysis steps, and science would focus on the problem formulation and planning stages because that includes experiment design. One would be wrong to assume that subjects focus on only a few of the steps in the PPDAC cycle. People from all disciplines must understand all parts of the cycle. A graphic of
the PPDAC cycle made by Statistics New Zealand is presented in the workshop (Statistics New Zealand).

The Problem step defines what questions to ask. This would include what needs to be known to answer the question, as well as defining what kind of data are required to answer that particular question. This helps establish a problem statement, otherwise known as a hypothesis. Foreman indicated that letting the pre-service teachers create their own hypothesis would make the activity more fun and engaging. Forsyth also indicated that statistics has the ability to provide evidence to prove or disprove the original hypothesis. Letting the participants have a personal relationship with the data would create a very engaging workshop activity.

The Plan step is all about organizing how one will address the problem. The facilitator would mention that the design, sample size, the process to collect the data, and the type of data would all have to be considered to create a successful plan. By the end of this step the pre-service teachers will understand how to create a method to find an answer to their hypotheses. The participants will be told how a faulty plan will skew their results. This step would be tied into activity 2, which is where a seafood company did a study on fish eaters and came to a biased conclusion.

The Data collection phase emphasizes how to organize data gathered for any statistical problem. The step is all about managing and organizing the data that were found in the plan or methodology. The participants should understand how data could be collected and organized so that it is easy to analyze. One could show students that a small sample could result in much different conclusions than a large sample. The
workshop facilitator would also show that faults in the Data collection could cause a mistake in the Analysis because the wrong data may be acquired (Foreman).

The Analysis step is when one processes and displays the data organized in the Data collection step. Participants should understand that data in tables and graphs are tools to understand data, and that it is critical to choose the correct representation. The participants should also understand the need to always question if the analysis is being conducted correctly. By the end of this step, the pre-service teachers will be shown that the graphs and tables could show a pattern. The facilitator will also point out that the improper graph can show an incorrect representation of the data and will indicate a faulty conclusion (Callingham and Watson).

The Conclusion step is when everything done so far in the PPDAC cycle comes together. This is when one takes the graphs and tables and interprets them. Based upon the interpretation, a Conclusion will be made and then compared to the Problem statement. The hypothesis and the conclusion should be harmonious. The participants should also understand that it is necessary to communicate the ‘why’ and ‘how’ one reaches a conclusion and that the process of getting to the conclusion is as important as the conclusion itself (Callingham and Watson).

The workshop needed the PPDAC cycle for a number of reasons. It needed to have a logical flow. The PPDAC cycle illustrates how data works to take out some of the fear that many non-technical students have for numbers. It was also logical to accompany the PPDAC cycle with an interactive example, where the pre-service teachers could think and analyze how the data flows. It was also important to
establish how CensusAtSchool could be used in the classroom. The PPDAC cycle can be used to show the application of CensusAtSchool and how it can be helpful (Callingham and Watson).

4.3.2.2 PPDAC Demonstration

Groves, Williams, and Doig thought the workshop should show a sample of what can be done with statistics. To prepare the attendees for the PPDAC cycle group activity that follows, the workshop has a demonstration on how to work with the PPDAC cycle to formulate a question and effectively go through the cycle to reach a conclusion. Using a CensusAtSchool sample, the facilitator will go through a specific example, showing each step of the cycle and explaining what is done with the data at each step.

The first step is the Problem step. To address this, the question should be understood and defined. The facilitator will take questions from the CensusAtSchool questionnaire and develop a hypothesis. Referring to the CensusAtSchool data file, the facilitator will find the examples “Do you have access to Xbox at home?” and the reaction time test. Using these responses to these survey questions, the facilitator will suggest the research question of “Do students that play Xbox have a better reaction time than those that don’t?”

At this point the Plan step is reached. The facilitator will note that planning has already been addressed because the data have already been collected. The audience will understand the importance of choosing a method of data collection. In the Xbox example the design of the study is an online questionnaire of secondary school students throughout Australia. The sample size is a random sample of 200 out of
about 112,000 students who took the questionnaire. Also, it is important to consider that the reaction time test is done on their computers.

The next step is the Data step. Here the facilitator has to show the management and organization of data. This will be prepared beforehand so that the facilitator can simply show what he/she did. The major points that should be addressed here are that all data should be organized together, cells without data should be erased, and that only the best of the left hand and right hand reaction times will be used. These points should be made while referring to a prepared spreadsheet.

The next step is the Analysis step. The facilitator will again refer to the spreadsheet and show the mean and median of the data. Depending on the experience of the audience, it may also be appropriate to include the quartile numbers and a box plot to represent the data.

From the analysis of the data a Conclusion can be made. The facilitator will ask the audience to make conclusions to the research question based on the analysis. The audience should conclude that Xbox players have a better mean reaction time and better median reaction time than non-players.

After the demonstration is complete, there will be a short discussion about things to think about. Some questions used are:

1. Could the speed of the students’ computers have had an affect on the result?
2. Would playing video games in general have a correlation with reaction time?
3. Would there be a correlation between reaction times based on how much the student plays Xbox?

After these questions are posed, the facilitator will then ask the participants for any other questions that might be asked about the example. Then the facilitator will note that it is always important to include a questioning phase like this one.

### 4.3.2.3 PPDAC Group Activity

Many interviewees indicated a need to include a group activity in the workshop. Gaye Williams, a lecturer at Deakin University, explicitly said that she would be more likely to use the workshop if there was an activity. Beeson also thought that providing a group activity setting would be very important in engaging participants. Mills and Giesbrecht agree that hands-on constructivist activities are much more effective than simply lecturing. In interviews with Rebellato, Callingham, and Watson, all suggested splitting the attendees into groups by discipline.

Many interviewees suggested the groups should create their own activity that can be used in the classroom. However, Groves, Williams and Doig stated that a curriculum development activity should not be included because the pre-service teachers may not be experienced enough to do so. Callingham and Watson said that pre-service teachers could not always produce an activity on the spot and often require a strong structure to guide them. Several interviewees suggested using the PPDAC cycle to guide the participants though the group activity (Callingham, Watson; Rebellato). Callingham and Watson added that single-discipline groups could focus on sections of the data analysis cycle that are most applicable to their discipline, being sure to make them aware of the full cycle.
When asked about content, Forsyth believed that providing examples of raw data, then asking how it would be used to teach a lesson would be a good activity. To determine the types of data sets, Gough stated that content often falls into two categories: subject interests and individual interests. He went on to add that focused subject interests might alienate some participants, whereas individual interests may seem trivial to others.

Tony Watt of Victoria University stated that teachers often have a hard time understanding the fact that statistics is a tool and often get caught up in the analytical portion. To address this, Professor Martha Cyr of Worcester Polytechnic Institute suggested that the activity be chunked into sections, providing the pre-service teachers with a clear understanding of the process of the activity.

Callingham and Watson believe that regrouping the audience after the activity and having each group report what they learned could be very helpful for pre-service teachers. In order to apply the knowledge gained from the group activity however, Groves, Williams, and Doig stated that with the limited timeframe, the pre-service teachers should be doing most of the thinking after the workshop takes place. Cyr similarly agreed, stating that the only way to inspire teachers is to have them do something themselves and physically see how it works and applies in the classroom.

The project group decided to focus the group activity on having each group develop a research question that could be brought through the PPDAC cycle to obtain a better understanding of the process. The topics that each group use in defining their research question also happen to be taken from the CensusAtSchool survey.
The instructions for creating a research question were very structured to cut down on the time necessary for groups to make a decision. Each group is provided markers and butcher’s paper for brainstorming ideas as well as a Survey Question Set containing a set of topics taken from the CensusAtSchool survey. Each Survey Question Set has a general interest topic with selected survey questions about environmental and water-related issues. Refer to Appendix F: Workshop Handouts for the complete Survey Question Sets.

After developing a research question, the groups of pre-service teachers are then instructed to use their hypothesis to work through the remainder of the PPDAC cycle. As they work through each step, they are instructed to address certain questions such as “How would you manage and organize the data? What tools might you use to analyze the data? How would you process the data and why? How would you present the data and why? And how would you use the results from your analysis to answer your research question?” Once these questions are addressed, the group will have successfully addressed each step of the PPDAC cycle. Although the participants will not be able to analyze the CensusAtSchool data during the workshop, the activity will provide them with the experience of working through the PPDAC cycle and using the thought process necessary to use the cycle correctly. Although research questions may vary from one group to the next, the project group believes that some pre-service teachers will be inspired enough to try and solve their research question after the workshop with the resources that ABS provides.
4.3.3 Workshop Conclusion

Technology and extra resources were discussed in many of the interviews (Beeson, Foreman, Griffin, Watt, Lane, Callingham, Watson, and Davies). The three resources chosen were: CensusAtSchool, Statpak Online, and Excel help. The project group chose these because the resources are all readily available for any classroom anywhere in Australia.

Katona, a practicing teacher, indicated that CensusAtSchool got her back into statistics. Another practicing teacher, Griffin, also gave praise to the program for its ease of use. CensusAtSchool is an education project wherein students answer questions of interest about themselves by completing the CensusAtSchool online questionnaire. The questionnaire response data are then released back to teachers and students providing real data for classroom use. CensusAtSchool is also in conjunction with the supporting activities that ABS provides. The project group elected to use the CensusAtSchool data in the workshop because it can be used to clearly illustrate the PPDAC cycle (Callingham and Watson). The pre-service teachers would be informed that Australian CensusAtSchool data would be merged with the data from different countries, such as Canada, England, South Africa, and New Zealand.

Information on how to find out more about CensusAtSchool is provided in the handout with the other supplemental materials. The facilitator will show a 3-minute clip from one of the CensusAtSchool professional development CD’s that will be provided in an ABS bag.
The facilitator will continue and explain how the pre-service teachers can use Statpak to create lesson plans based upon ABS data and the PPDAC cycle. Statpak showcases ABS publications selected for their relevance to the curriculum. The subjects that ABS has for Statpak are Agriculture, Arts, Careers, Commerce, Crime, Economics, Environmental Studies, Geography, History, Tourism, Indigenous Studies, Industry and Enterprise, Information Technology, Mathematics, PE and SOSE. The facilitator will tell the audience to refer to the handout to find out how to find Statpak materials. Also, the facilitator will explain how to find Excel help on the ABS website. Additionally, both Lane and Rebellato suggested that we should communicate that all the resources that ABS provides are relevant, useful, and free.

Though there were many suggestions for graphing calculators, it was decided to not include self-help resources for them because ABS cannot encourage teachers to buy a particular brand of calculator. For example, South Australia requires their students to buy Casio calculators, whereas other states like Victoria require their students to buy TI calculators. ABS support for either brand of calculator (or both) would not be appropriate for a government organization. Also, the interviews with practicing teachers indicated that graphing calculators were only required for years 11 and 12, moving the need for graphing calculator support out of the scope of the project.

There will also be an evaluation form included in the packet of information given to the pre-service teachers. It will be filled out upon completion of the workshop. The evaluation will establish if and how the presentation of the material was helpful. The project group also recommended that there should also be longer-term evaluations at 9 months and 2 years after the workshop. These will determine if the participants
used the material in the classroom, as well as determining the usefulness of the material and techniques presented in the workshop.

Before the participants leave, a bag of promotional material will be given. This could include materials such as a CensusAtSchool pen, ruler, and calculator. There will also be CensusAtSchool professional development CDs, as well as a CensusAtSchool CD that teachers can use with their students. The bags will also contain a brochure on NESU and CensusAtSchool. The facilitator will also provide contact information (email, phone, website, and a mailing address) so the participants can get into contact with individuals at ABS to further understand the free resources available to them. This would be a subtle way of advertising to the attendees to remember to use ABS resources (Rebellato; Groves).

4.3.3.1 General Suggestions

From interviews, many general tips were found on how to conduct the workshop. Though they do not fit in any general category, they have still proved helpful. This is a compilation of all of the different tips that were gathered.

4.3.3.1.1 General

Since this workshop is initially going to be implemented into the university curriculum, there is a possibility of the students receiving supplemental material the day before that would be turned into the professor (Callingham, Watson). There could be a survey that the professor would hand out, then tally, which would then be used as part of the introduction to the workshop. The same questions would be asked again in class and the survey would show the importance of the data collection process.
4.3.3.1.2 *Use of Technology*

There have been mixed messages on how to use technology in the classroom. It appeared that there were three different technologies that could be used: graphing calculators, Excel spreadsheets, and Google Earth.

Teachers that were interviewed indicated that Excel is the simplest and most straightforward way of using technology in the classroom. However, this does have its disadvantages. For example, it takes a long time to get students into a computer lab, setup, and ready to use Excel. Excel can also be unforgiving and detract from the students learning important statistical concepts because there is also a learning curve for Excel. For example, forgetting a parenthesis, an equal sign, or other small detail will prevent the software from processing the student’s work. This would detract from the student’s overall learning experience (Foreman, Katona).

However, there is also promise in the use of graphing calculators. The calculators are also a lot quicker to use in the classroom than Excel. The calculators are also programmed to do complicated calculations such as integration in a few simple steps, so teachers can focus more on the conclusions from the analysis (Stewart). Students must have a graphing calculator by year 11, and some students have graphing calculators by year 9 (Foreman, Katona; Casey, Stewart, Starkey). The issue with using graphing calculators in the workshop is that teachers are not experienced enough with using them in the classroom and the use of calculators should not be a focus of the workshop (Forsyth).
Another possibility is to use Google Earth in the classroom. The program is very visual and simple to use. The students can get many different kinds of data, ranging from crime data to the number of inches of rainfall received, to a city’s population. Currently there is not much curriculum themed on using Google Earth, but it is still an attractive possibility to use for the workshop. Google also has an educator site with different ways to incorporate Google Earth into the classroom (Callingham and Watson).

4.4 Workshop Evaluation

The project group presented the workshop to five employees of the ABS and one project advisor to test its effectiveness and to get suggestions from them. Out of this trial run, the project group conducted a SWOT analysis of the workshop with those that attended.

4.4.1 Workshop Performance

The trial workshop was conducted at the Australian Bureau of Statistics Melbourne office on 18 April 2007. There were six participants present, each with different educational backgrounds. Those present were: John King (Literature), Soo Kong (Humanities), Holly Ault (Mechanical Engineering), Nick Peter (Economics), Peter Riches (History), and Gai Mooney (Psychology). The workshop went very smoothly and there were no major problems. The workshop ran for 1.5 hours, which was precisely the duration goal. Though their suggestions were helpful, the participants’ responses may be biased. Considering most participants were reasonably experienced with statistics, their reactions may have been different than those of pre-service teachers attending the workshop.
4.4.2 Strengths

Overall, the trial run of the workshop was received quite well. The participants found the content to be engaging and believed that the interactive elements of the workshop were a positive addition. Their perceptions of the structure were also constructive, stating that the workshop had a coherent flow that did not lose the audience. Comments on the presentation style were encouraging as well. The audience was very pleased with the timing and showed that a lot of effort was put into developing and practicing the workshop. The participants also felt that the project group portrayed confidence and had good delivery, ultimately enhancing the overall presentation of the workshop. The variety of teaching methods such as lecturing, asking questions, and providing activities was effective in educating them.

The participants found the specific content to be relevant to the target groups in the trial run. Introducing and developing the PPDAC cycle through the group activity was a beneficial activity and the inclusion of the butcher’s paper for brainstorming was helpful. The workshop effectively promoted statistical literacy at its very basic level and all of the participants stated that avoiding the use of the word ‘statistics’ and using non-threatening terminology was an excellent approach to introducing the subject to the audience.

4.4.3 Weaknesses

In the analysis portion of the PPDAC demonstration, quartile numbers and a box plot was used. The participants of the trial workshop initially found this to be confusing and distracting. The audience indicated that utilizing box plots to display the data raised more questions than answers among participants that were not familiar with the
representation method. Some participants added that because the box plot was unclear it detracted from the lesson of demonstrating the process of the cycle.

Though the group activity was engaging overall, there were some gaps in its structure that were pointed out as weaknesses by the participants. First, they indicated that the group activity instructions were not as clear and structured as they could have been. At times, groups became confused as to what they needed to do next. Also, there was no real reflection period for the groups at the end of the activity. Participants found this to be a rather abrupt end to the activity and felt as though it could have been expanded to fully discuss each group’s process for the benefit of each individual’s learning experience. Additionally, participants indicated that there was little or no connection made between the PPDAC cycle and the group activity, which would have been helpful in emphasizing the process.

4.4.4 Opportunities

General opportunities for improvement included cleaning up the overall script. Participants suggested that the project group thoroughly address the procedure and goal of each activity within the workshop notes. Some participants also suggested that the hypothesis bullet point under the analysis step in New Zealand’s PPDAC cycle seems out of place and should be moved to the problem step.

Regarding the article activities, some participants suggested that in order to stress the lesson of the pushy fish-eater activity, it would be helpful to include another slide that both addresses the sampling numbers and possible interrogation questions. Also, some participants indicated that the examples in activities 1 and 2 be updated to reflect present-day articles.
Participants also raised discussion about the VELS activity. They specified that an emphasis should be placed on pointing out and explaining the cross-curricular impact that data has. They added that this could be accomplished by encouraging teachers to use data as a means to develop cross-curricular projects.

Various participants agreed that, during the group activity, conducting frequent group check-ups or structuring the activity more would help in moving the audience smoothly through the activity. There were also suggestions about performing a live demonstration of working with the PPDAC cycle using one of the group’s research questions. Regarding the composition of topics in each Survey Question Set, suggestions were made to include a wider range of topics to satisfy the needs of more disciplines. Some additional topics included states/territories, postal code, gender, and various other survey questions from the CensusAtSchool survey.

The participants also made some suggestions for the end of the workshop, indicating that the connections between the group activity and CensusAtSchool need to be made much clearer. Additionally, when describing CensusAtSchool, the audience felt as though more background information could be included. Some participants indicated that mentioning the workshop is an exercise in statistics at the end could help dispel any bad experiences that audience members once had with statistics. Also, when showing where resources are located online, one participant indicated that the workshop could be modified to promote the new education web pages as they are promoted from the developmental stage.
As a long-term opportunity, some participants indicated that the workshop serves as a good template to build on. The basic structure of the workshop could be used to increase statistical literacy beyond just teachers, but also within the government and the media as a fundamental course for learning statistical concepts and data handling methods.

4.4.5 Threats

The participants of the trial run identified a major threat to the outcome of the workshop as a lack of knowledge by attending pre-service teachers. If inexperienced pre-service teachers are grouped together, they may not get through the entire activity and ultimately get discouraged from further exploring the subject. Also, participants indicated that participants that focus on the details of a particular activity often get caught up with the specifics and lose sight of the concepts that are being portrayed and valuable time is lost. Most participants indicated that this could easily happen during the Xbox example and possibly in the news article examples.

Other threats that were brought up included not getting the desired range of disciplines in the audience. Participants believed that fewer types of disciplines present could have a drastic effect on the outcome on the VELS activity. Additionally, not getting permission to use New Zealand’s specific PPDAC cycle could prove to be a threat, forcing the project group to develop a unique representation of the cycle.

A less significant threat that falls out of the project group’s control is that of having an inexperienced facilitator. Without proper training and familiarization to the workshop, it is likely that the workshop might not be as effective as it could be.
4.4.6 Additional Feedback

The additional feedback provided by the audience included minor aesthetic changes. The workshop materials were not in Australian spelling. The ABS logo has been updated since the project group created the slide design. Pre-writing the KLA activity matrix on the board could save time as participants provide findings. In order to consistently refrain from explicitly using the word ‘statistics,’ the word ‘statistical’ should be omitted from the conclusion step slide. To make the workshop gender neutral, it was recommended that the presentation use more clipart of females. Regarding terminology, ‘lesson plans’ are known as ‘classroom activities,’ replace the word ‘stuff’ with ‘material,’ use ‘facilitator’ instead of ‘proctor,’ and it is ‘an hypothesis’ rather than ‘a hypothesis.’

4.4.7 Revisions to Workshop

Several minor revisions were made to the workshop after the project group conducted a SWOT analysis. The project group made the PPDAC demonstration simpler by removing the quartile and box plot concepts. Only the means, medians, minima and maxima will be discussed to prevent confusion. Also, the project group added more discussion to the group activity to ensure a sufficient spread of ideas. All terminology and Australian spelling errors were corrected as well.
5 Conclusion

The workshop serves as a solid structure with which to encourage the use of statistics in the classroom. In demonstrating and discussing the importance of statistics in society and in the classroom, three important messages are conveyed to pre-service teachers: statistics is encountered on a regular basis, statistics is necessary to make informed decisions, and statistics is a subject that can deepen a student’s understanding of any discipline. By the conclusion of the workshop, pre-service teachers will understand how statistics applies to their discipline and experience a method for introducing statistics into the classroom. Additionally, resources are provided to help each pre-service teacher acquire further information when beginning to apply statistics into the classroom.

The content of the workshop remains generic enough to satisfy the needs of pre-service teachers of Mathematics, Science, and Social Science without any modification. This convenient attribute provides the flexibility needed for scheduling workshops at a variety of universities, allowing students from any combination of disciplines at varying skill levels to attend.

Though targeted at final year pre-service teachers, the overall structure and content of the workshop have been kept basic enough that, with little modification, the workshop can be adapted to fit the needs of other audiences such as practicing educators, media, and secondary college students. Most importantly, however, the workshop’s adaptability serves as a positive step for increasing statistical literacy throughout Australia.
6 Recommendations

After much research and many interviews, many things were encountered that could aid the implementation and improve the content of the workshop. Due to time constraints, the points could not be addressed, but it is recommended that the ABS consider them.

6.1 Workshop Implementation

The implementation of the workshop is as important as the workshop itself, but a full implementation plan is out of the scope of this project. There are several things that should be considered for the proper implementation of the workshop. These things include a trial among pre-service teachers and a comprehensive business plan that includes a marketing strategy targeted at education and statistics organizations.

6.1.1 Trial Workshops

Before the workshop is implemented, it is recommended that the ABS perform workshop trials with pre-service teachers. Although the workshop has already been performed with no major faults, the audience in the trial did not consist of pre-service teachers. A trial workshop with pre-service teachers is essential to find any major faults. The ABS can contact the university professors that were interviewed to find out how this can be done. See Appendix D: Interview Contact List.

6.1.2 Business Plan

It is recommended that the ABS produce a business plan for the workshop. The business plan would cover a marketing plan, an operational plan, and a financial plan. A business plan would cover all aspects that must be considered for the implementation of the workshop.
6.1.2.1 Marketing

As part of the business plan, it is recommended that the ABS produce a marketing strategy to appropriate education and statistics organizations. Some organizations considered were the Victorian Curriculum and Assessment Authority (VCAA), Teaching Australia, universities around Australia, and the Statistics Society of Australia Inc. (SSAI).

6.1.2.1.1 Universities

It is recommended that ABS contact individuals who create the lesson plans for university education departments and collaborate with them to get the workshop into the university curriculum. Many interviews suggested that it would be appropriate to implement the workshop as part of education university courses (Gough; Groves, Williams, Doig; Callingham, Watson). To do this the ABS would have to find a way to convince universities that the workshop is effective. The trial workshops with pre-service teachers, as recommended above, are needed to demonstrate the effectiveness of the workshop.

6.1.2.1.2 VCAA

The ABS should lobby the Victorian Curriculum and Assessment Authority (VCAA) committee to include more applications of statistics in the curriculum. The Victorian Curriculum and Assessment Authority (VCAA) is the committee that determines the education requirements for the Victorian Education Learning Standards (VELS). Though there are statistics-based requirements for many of the subjects, they are not strong enough and in some cases are not stated explicitly enough. Every 5 years this committee reviews the curriculum, and the next review will be in June 2011.
6.1.2.1.3 Teaching Australia

The ABS should work with Teaching Australia to get education standards implemented nationwide, while ensuring that statistics is being stressed in the standards. Teaching Australia is an organization that is attempting to develop nationwide education standards. All states in Australia have different teaching standards and teaching organizations that provide similar resources. However, Teaching Australia is making slow progress towards implementing a national curriculum.

6.1.2.1.4 Subject Associations

It is recommended that the ABS contact subject associations to get their support on the importance of statistics in their respective subject. If statistics is accepted among subject organizations, educators in those subjects will be more likely to incorporate statistics into their classrooms.

6.1.2.1.5 Statistical Societies

It is recommended that the ABS work with the Statistical Society of Australia Inc. (SSAI) as well as other statistical societies around the world to earn their support for the workshop. These organizations could help the workshop become more widely known and accepted. Additionally, the workshop may be able to be modified to apply different countries.

6.2 Workshop Modification

After the workshop trial, several small adjustments were made as described in the Revisions to Workshop section. There are several things that could be done to further improve the workshop. These include modifications based on the trial, for different
states and territories, for practicing teachers, to promote interdisciplinary projects, and for the media.

6.2.1 Trial Modifications

After the workshop trial, it is recommended that the ABS make the appropriate modifications to the workshop. The modifications will be made based on the responses on the evaluation form. The evaluation form may also need to be modified if the evaluation form is not producing helpful feedback.

6.2.2 Other States and Territories

It is recommended that the ABS modify the workshop to target other states and territories with the different standards. The workshop that was created is tailored to VELS standards, or the Victorian Essential Learning Standards. To modify the workshop for other states and territories, instead of using the VELS, the states’ or territory’s associated standards would be used.

6.2.3 Practicing Teachers

It is recommended that the ABS modify the workshop for practicing teachers. This would be easy to accomplish, as only two parts of the workshop would have to be changed. The VELS activity should not be included because most practicing teachers are very familiar with their standards. Instead, the facilitator might ask how statistics applies to their disciplines. Additionally, the workshop’s main activity should be modified to allow the teachers to create their own cross-curriculum data-centered lesson plans.
6.2.4 Interdisciplinary Projects

It is recommended that the ABS modify the workshop to encourage interdisciplinary projects. Statistics is a subject that can be easily implemented into interdisciplinary projects within secondary colleges (Griffin). Lane, McInerney, and Glac indicated that having a workshop that had integrated units, or a project that is done in multiple classes, would allow students to become more comfortable with using data in the classroom. Gough indicated that there have been efforts to incorporate more interdisciplinary projects into the classroom, but teachers lack the confidence to do so. Therefore, it the workshop may be a good way to give them this confidence. The workshop already explains how different subjects put more focus on different parts of the PPDAC cycle. This could be used as the structure of this modification.

6.2.5 Media

It is recommended that the ABS modify the workshop for media personnel. The media often misrepresents data and communicates these mistakes to the public. A workshop very similar to the one created for this project targeted to pre-service teachers could be given to the media to serve this purpose.
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Appendix A: Interview Questions for Education Professors

We are a group of students from Worcester Polytechnic Institute, which is a university in the Northeast of the United States. We are working with the Australian Bureau of Statistics to create a workshop targeting cross curriculum pre-service teachers to help them incorporate statistics into the classroom. By the end of this interview we hope to understand how to engage pre-service teachers and acquire any suggestions you have regarding our workshop.

1. What is your position, how long have you been teaching and what kind of pre-service teachers do you teach?

2. What level of statistics are pre-service teachers required to reach? Are they required to take a whole course in statistics or is it included as part of another maths course?

3. How should we present the material in our workshop so that pre-service teachers become more comfortable and motivated to teach statistics?

4. Can you think of any reasons why teachers don’t teach statistics in the classroom?
   a. How can we improve that?

5. Can you think of any ways non-maths teachers at different levels (such as Geography, History, Economics) can incorporate statistics into their curriculum?

6. How do pre-service teachers usually approach the task of curriculum development?

7. Are you aware of any programs that target teachers across the curriculum to encourage the use of a certain subjects in their classroom?

8. How would we get pre-service teachers to attend this workshop?

9. Realistically, what should the duration of our workshop be?

10. At what point in their studies would this workshop be most appropriate?

11. Would it be appropriate to implement it in the classroom?

12. Do you know of any new and innovative ways of teaching that we might be able to incorporate into our workshop?
   a. Do pre-service teachers know how to use programs such as Excel

13. What are the professional development requirements for teachers?

14. Is there any way we could ask some of your pre-service teachers some questions in the near future? Could you refer us to any of your colleagues who you believe may be helpful for our project?

15. Is there anything that you wish to add?
Appendix B: Interview Questions for Practicing Teachers

We are a group of students from Worcester Polytechnic Institute, which is a university in the Northeast of the United States. We are working with the Australian Bureau of Statistics to create a workshop to help teachers incorporate statistics into the classroom. Our primary focus is to target cross curriculum pre-service teachers, however, our workshop may also be used for professional development of practicing teachers. By the end of this interview, we hope to know your background knowledge on statistics, and if or how you use statistics in the classroom, and acquire any suggestions you have for our workshop.

1. What do you teach and at what level?
2. Non-Maths: Are you comfortable with general statistical concepts?
3. What do you think could make statistics more approachable for pre-service teachers and students?
5. Non-Maths: Do you teach any statistics such as averages, percentages, graphing techniques, and data analysis in your classroom?
   a. Yes
      i. Please give examples.
      ii. Do you use any resources or technology to help you teach statistics to your students? Why or why not? Give examples.
      iii. What encouraged you to teach statistics in the classroom?
      iv. Can you think of any reasons why some teachers don’t teach statistics in the classroom and how do you think we can improve that?
      v. Have you used any group activities to teach statistics?
   b. No,
      i. What are the reasons for not teaching statistics in your classroom?
      Do you assume that students are already familiar with statistical concepts?
      ii. What would motivate you to teach statistics in the classroom?
      iii. Would you be comfortable using technology like online resources and spreadsheets to teach statistics and are these available for you?
6. Non-Maths: What would motivate you to come to a workshop like this one?
7. Maths: What would motivate non-math teachers come to this workshop?
8. If you were a trainee teacher and you were attending our workshop, what would you like to see?
9. Realistically, what should the duration of our workshop be?
10. At what point in their studies would this workshop be most appropriate?
11. We want our workshop to be gender neutral. In general what topics of discussion get both boys and girls excited?
12. What are the PD requirements for teachers?
13. Is there anything that you wish to add?
Appendix C: Interview Notes

Interview with Martha Cyr on 16 February 2007

The professor interviewed was Dr. Martha Cyr of Worcester Polytechnic Institute (WPI).

1) Background:
   - Dr. Martha Cyr is the director of K-12 outreach at WPI. In this position, she oversees outreach efforts for both teachers and students to advance their Science, Technology, Engineering, and Mathematics backgrounds. Professor Cyr also serves on the board of the Engineering in Mass. Collaborative (EiMC). The EiMC is a group in Massachusetts that meets regularly to try and improve the exposure of engineering to students. The group switched to focusing on STEM in order to incorporate the other areas of technological disciplines and not just engineering.

2) Pre-service statistics requirements:
   - 

3) Presentation of workshop material:
   - Mathematicians tend to think that math is for the beauty of math alone, however math is a very useful tool and it is very important to see how it can be applied.
   - You want to think about all the subjects that a certain discipline might come across and find the relevant statistics that can be brought out.
   - You want to be relevant with the material that you present which means you want to move away from “what’s the probability of finding a red M&M in this bag?” Think about what the pre-service teachers would teach in a unit and find the statistics that supports it.
   - Make sure that when presenting a problem to solve in your training resource that it is gender neutral. You don’t want to alienate any individual or group of people.
   - Also, make sure to do the activity with the teachers; don’t just lecture at them. Create an activity and worksheets that are chunked out in sections. This gives them a clear understanding of the process of the activity.
   - A good way to start is getting to know whom you are dealing with. You can do this by having them answer questions based on what they know and what they don’t know. When they are done filling out the questions, you can have them compare their answer with actual facts. The basic idea is to provide something that asks a question, see what they know, provide them with the necessary information to get a better understanding, and then show them how the information applies.
   - If ABS has existing materials and wants you to use them, look at what’s there and figure out a way to get a teacher to use it in a slightly different manner that’s more comfortable for them.
• The only way to inspire teachers is to have them do something themselves. They also can’t be afraid of doing it and have to be willing to take it to the classroom and physically see how it works and applies.
• You want to give the teachers a small, manageable amount of material and have them work with it. If those little bits of information work, then show them where they can get more information, i.e. ABS’s website.
• If the workshop has to be long, think about chunking the time, no one wants to attend a solid 6-hour workshop. 1-2 hour chunks work the best if you conduct them correctly. These 1-2 hour blocks should contain small but engaging activities and material.
• Educators are fabulous at knowing how people learn and how to manage a classroom. Their experience is in that more than the subject quite often. With that, perhaps you want to approach the project with the idea that their experience in knowing ways to help people learn and think is just as important as providing the statistical knowledge and concepts.

4) Reasons why teachers don’t teach statistics
• -

5) Cross curriculum application of statistics:
• For example, when dealing with science, think about the experiments that are done and where statistics applies. Biology might deal with the probability of getting a disease, Physics often have to show the repeatability of an experiment, and History might look at population growth statistics.

6) Curriculum development by pre-service teachers:
• -

7) Cross curriculum programs:
• -

8) Motivating pre-service teachers to attend the workshop:
• It might not be a matter of motivating pre-service teachers to attend but rather motivating faculty to accept it into their classroom. University faculty are often entrenched in the way they teach that it is often hard for them to change their methodology. They sometimes think that if this is how I was taught then it should work for my students.

9) Innovative ways of teaching:
• The Teacher Enhancement in Pre-College initiative is a 4-year grant from the National Science Foundation that Professor Cyr worked on while at Tufts University. The idea was that as new standards emerged for including engineering in the curriculum, K-12 teachers probably didn’t have any experience with engineering at all. In order to educate the teachers, the program started with high school teachers and had them work with a graduate student during the summer developing engineering lessons over a 2-week period. The next summer, these students and teachers ran the workshop and taught their piers. Having a teacher talk with other teachers can sometimes be more inspiring than having a superior as the speaker.

10) Professional development requirements of teachers:
• -
Interview with Pat Beeson on 15 March 2007

The professor interviewed was Pat Beeson, a former teacher of Presbyterian Ladies College.

1) Background:
   • Pat Beeson was a geography teacher of Presbyterian Ladies College. She is currently working for ABS developing different education materials.

2) Pre-service statistics requirements:
   • -

3) Presentation of workshop material:
   • Make statistics visual
   • Look at the computer program Inspirdata. It makes data visual.
   • Draw material that relates to the student, or data that they’ve collected.
   • Don’t talk a lot
   • Break it up
   • Try to get them engage and share their ideas in groups

4) Reasons why teachers don’t teach statistics
   • -

5) Cross curriculum application of statistics:
   • Year 7 geography: Going to the Melbourne cemetery and identify the number of graves, and would have worked out the country of origin. Students would then draw a pie graph or a column graph.
   • Year 8: Individual research project and would graph data. We would often say to present as a table, column graph, pie graph, and in geography a map. The students would choose their own topic.
   • Year 9: Graphical representation on top of a map. Proportional circles based upon geographical data. Did an energy unit, looked at coal and oil statistics. Had to place countries into the small, medium, or large category.
   • Another Year 9 project: Sampling of a river and counting how much paper, plastic, and glass there is. Enter into a table and used a mapping program.
   • Year 10, looked at population, tourism statistics
   • Students should be able to look at simple data tables, grids, interpreting maps.
   • One of a geographer’s task is to find statistical data and be able to place on top of a map.

6) Curriculum development by pre-service teachers:
   • -

7) Cross curriculum programs:
   • -

8) Motivating pre-service teachers to attend the workshop:
   • -

9) Innovative ways of teaching:
   • Using excel
   • Inspirdata for interactive, visual statistics
   • Using tsunamis End on a positive note, like how can we protect ourselves from tsunamis. Questions to ask are:
   • What is a tsunami, what causes a tsunami, when have tsunamis occurred, effects of a tsunami and ways that we can protect ourselves from tsunamis.
• Using numerical data: timeline or tsunamis, loss of life, times when the tsunami occurred in different countries, speed at which it travels
• Put in total death toll per country, and look at percentage.
• Get the participants to do, instead of listen. They are all going to have different views and ideas and opinions, best to try to engage that.
• Try to get them to engage in groups.
• Have the statistics made personal to them.
• Have them pick their favorite suburb based on certain statistics (crime, public trans, parks etc)
• For the workshop

10) Professional development requirements of teachers:
• -
Interview with Debra Foreman and Veronika Katona on 16 March 2007

Debra Foreman and Veronika Katona are teachers from Vermont Secondary School.

1) Background:
   - Debra teaches mathematics in years 7, 10, and 12.
   - Veronika teaches mathematics in years 7, 8 (started recently), and 9.

2) Statistics comfort:
   - Both feel comfortable with general statistical concepts (mentioned graphing and stem-and-leaf plots).
   - Debra did statistics while at her university, however she felt that the concepts she learned there were a waste of time and never used them.
   - Both felt that being comfortable reflected on one’s confidence in the subject. In their school, statistics is often the last topic on the agenda to teach and gets dropped because time runs out (occurs often at year 10).
   - At their particular school, students do use graphing calculators. Years 11 and 12 are required to have graphing calculators.
   - Veronika believed that the CensusAtSchool program got her back into statistics. She found it to be very helpful at getting the students engaged as well and hopes to do more projects in the future, incorporating year 9 students as well. She felt though that it took a long time for students to acquire the data from the website.

3) Approachability of statistics:
   - Both found that the statistics examples in the textbook were quite dry. Students should collect data that is relevant to them.
   - VELS try to crowd a lot of material into a subject and teachers are often overwhelmed with the prescribed curriculum.
   - Debra thought the most important thing is making a question and answering it with statistics.
   - Debra found that examples of misleading statistics are rare. Students do find these interesting however. The results of a survey can completely depend on how the questions are asked.
   - Statistics process is as follows: (1) Collect, (2) Organize, (3) Analyze.
   - Teachers often don’t automatically see the connection between their subject and statistics.

4) Using statistics in the classroom:
   - Again, Veronika uses CensusAtSchool. Claims she is not that computer literate.
   - Both said they needed help with Excel functions and found that the materials and manuals provided from professional development courses were wordy and too complicated. Debra though that excel should be presented so that year 7s and 8s can do it.
   - Their school had computer rooms, but teachers sometimes don’t use computers because technology can often be frustrating in class.
• Height activity: Have students line up from shortest to tallest and determine the height median, mean, mode and quartiles. Box plots.
• Gummy snakes activity: cut the gummy snakes at random lengths and stretch them. Measure the data of length up until they break and collect and analyze the data. Afterwards, the students get to eat the gummy snakes.

5) Suggestions for the workshop
• Debra thinks kids really enjoy a discussion and love it when something they learn relates to something that happened their past
• Veronika thinks if kids like it then teachers will like it
• Self-paced excel training might be good and showing the usefulness of graphing calculators

6) Gender neutral statistics activities:
• ABS material is very neutral
• Reaction time test: Hypothesize that girls are faster than boys and have them test their reaction time using a computer program.
• Give examples of different applications of mean, median, and mode: A company that manufactures light bulbs might rather advertise a median lasting time than an average. Some light bulbs last 1000 hours while some blow out on the first use.
• Give them mini M&Ms and have them count the proportion of colors and compare the claimed number of candies on package.
• “Is that a good question?” activity that analyses how the bias of survey questions.
Interview with Wayne Griffin on 19 March 2007

Wayne Griffin is a teacher at Mount Waverly Secondary College.

1) Background:
   - Mainstream maths at year 7.
   - Year 7 maths has two levels: mainstream math and advanced math. Year 8 has three levels. Year 9 has 4 levels. Year 10 has 5 levels. The school and parental consultation determine the path the student takes through the mathematics block.

2) Statistics comfort:
   - Feels he is comfortable with statistics. Believes that many teachers, however, are not comfortable with statistics, especially when it comes to technology (specifically excel and graphing calculator).
   - Looked at CensusAtSchool data and excel. Felt that it was easy to use and very applicable.
   - Excel should be kept simple (commands like average, graphs, tables, etc.).
   - Mentioned how USB drives are often used in the classroom as well to help facilitate homework.

3) Approachability of statistics:
   - Capturing students at year 7 is key. “If you can capture them at year 7, you’ve got them”
   - For years 7 to 8, make statistics real life and hands-on. Present them with a problem that directly affects them.
   - Year 7 has a lot to do with bar graphs and line graphs. Therefore, it needs to be very visual. Introduce mean, median, mode, and other statistical functions at year 8. Overall, the students enjoyed an open-ended task (with a structured rubric of course).

4) Using statistics in the classroom:
   - One example was graphing and comparing literacy vs. GDP.
   - Another example was the ‘Cola Wars’ project where students would essentially bring in something and survey the class to collect their data. The feedback from this particular project was very promising.
   - Another example was that of showing graphs and having students create a story corresponding to the graph.
   - Felt that statistics was something that schools neglect at times and could be affecting the students later on. Statistics is the last topic taught and is often skipped because of that. This shouldn’t happen, it’s the most relevant math they do and this school has made a deliberate push to make statistics more important.
   - What is done in maths should be transferable elsewhere. Using the CensusAtSchool program has proved to be a big winner for cross curriculum activities. There is an inherent incentive to survey the class then compare the data with the rest of the world.
   - Rubrics are used to measure the progression of success.
• An effort should be made to make sure kids are coupled with an understanding of both the literacy and numeracy associated with statistics.
• Short-term activities provide a good basis of knowledge and understanding. Long-term activities provide a more enjoyable personal experience and often require the knowledge and understanding provided by short-term activities.

5) Suggestions for the workshop
• His Professional development courses were for cross-curricular applications. Tried to make it interactive for participants.
• Reputation helps to motivate participants to come to a workshop.
• When pitching a professional development workshop, try to incorporate activities that teachers can use in the classroom without them having to think about it.
• Felt that mathematics teachers don’t teach the questioning part of statistics, just the numbers. Mathematics teachers should start with questions and then the numbers. Similarly, Geography teachers, for example, should teach the numbers first and then the questions.
• Teachers are looking for quick fixes to get kids interested, motivated, etc. They are looking for a tool to act a structure for progress assessment.
• Capture the audience first. Ask a question, provide a ‘pre-test’…just as long as you challenge and engage the participants at the very beginning. Pitch them something they don’t know while using an example that most everyone in the room will understand and relate to. For example, when talking to geography teachers, use water questions about the drought.
• Be enthusiastic as well. This, in turn, will engage the participants.

6) Gender neutral statistics activities:
• Cars, fashion colors, and food often go well with everyone. Using Australian sports tend to be too focused and can leave out other nationalities. Also, Australian laws are beginning to prohibit the dispersal of food among students.
• Pre-service teachers may ask “How can I apply this in the class?” A workshop that is open-ended that is transferable across the states is preferred. A topic should have the ability to relate to anyone. The best activities were the ones that get students to question why numbers or trends were there. Pre-service teachers don’t need to see that something has been classroom tested.
Dr. John Gough is a senior lecturer at Deakin University.

1) Background:
- Has been at the university level for over 30 years. 8 of those years have been focused towards secondary education, however most of his time has been spent working with primary education.
- Taught as a secondary school teacher for a period of his career.
- In his undergraduate career he did statistics up to his second year of his bachelors degree. At that point he decided to switch to math logic instead of statistics.
- In general, pre-service teachers fall into two categories: primary and secondary. Primary teachers are often classroom generalists for K through year 6 (full range of subjects) but some do have specialist training in subjects such as art, music, etc. Secondary teachers take more specialized training for subjects such as math, science, English, etc. Secondary teachers are trained in two ‘methods’ that are unrelated (for example, math and dance, language and math, etc.) to improve diversity in knowledge.

2) Pre-service statistics requirements:
- There is no specific course available for statistics.
- For primary students, subjects include “chance and data” involving graphs and statistics. Training also exists regarding data based investigations (for example, posing a question and then collecting and analyzing the data). Other topics include mean, median, and mode. Graph ideas are also developed to understand differences and uses of bar, histogram, and line graphs. Discussion of x-y axes is also included.
- For secondary students, it is assumed that they learned stats in previous math courses while going through the primary education program. Sometimes students might not have retained much statistical training from past courses.

3) Presentation of workshop material:
- Make sure that any technical term listed in the workshop or presentation is explained in a clear and understandable manner. For any digitally distributed presentation, hot links can be used on technical terms. VELS makes use of hot links throughout the documents.
- Make the subject matter accessible for the individual. This splits into two veins, subject interests and individual interests. It would prove to be difficult to do both at the same time.
- Subject interests, thought very interesting to subject specialists, may alienate participants if the topics become too focused.
- Individual interests, though universally applicable, might seem trivial to some participants. The topic, thinking that they know all there is to know about it, may discourage these participants from taking something out of the workshop.

4) Reasons why teachers don’t teach statistics
• There’s an idea that subjects are ‘water-tight.’ For example, if there were math in a poem and I were an English teacher, I might skip over it because I just don’t want to deal with the mathematics.
• Efforts have been made to develop cross curricular projects into the class but it seems as though that teachers lack confidence in doing those types of projects. It is an idea that is unfamiliar to what they experienced in school.

5) Cross curriculum application of statistics:
• Mathematics tends to be avoided in most other areas because the descriptions often get too technical. If the math isn’t truly relevant to the topic, then you get an almost unintelligible description of how mathematics relates. This is the big turn-off.
• Use historical news, work categories, lifestyles, etc. If the math comes naturally from it then teachers will use it without question.

6) Curriculum development by pre-service teachers:
• In Victoria, and probably other states as well, student teachers look at the VELS to provide a framework for the lesson so that they can link the progress of students to the standards. From there, they determine the exterior to suit their style.
• Sometimes the VELS are hard to bring right to the classroom. This leads teachers to go to textbooks of familiar content and look for suggestions from the text.

7) Cross curriculum programs:
• There are some that exist. Back in the 1970’s, a movement resulted in encouraging reading in all subjects. Similarly in the 1990’s, Dr. Gough was involved with developing a program to promote numeracy for secondary teachers. This involved with teaching language in mathematics.
• For examples of this, take a ‘non-mathematics area’ and look at the potential or demand of mathematics in that area. Look at time periods and geography.
• Mathematics also comes up frequently in articles in the media, such as trends, graphs, tables, and pie charts. Show students papers that have persuasive charts and teach them about the implications of non-fiction and misleading information.
• All of these courses mentioned before are semester long courses.

8) Motivating pre-service teachers to attend the workshop:
• The ‘giveaway’ is the bait for going, especially if they feel it will be useful.
• If you can convince them that they can use it the next day without any effort, you’ve already sold it.
• Ready-made lessons are also very helpful.

9) Innovative ways of teaching:
• PowerPoint slides are becoming more prominent. These electronic slides can be brought to a website to provide ready-to-go lesson plans that are easily accessible.
• He believes that 50% of pre-service teachers regularly use excel. In terms of lessons with excel, provide ‘how to’ sheets and include useful formulas and where to find them. He states that even he finds the formulas hard to access,
claiming that very little sharing of knowledge goes on regarding formulas in excel.

10) Professional development requirements of teachers:
   • He was not sure of the exact requirement. Believes it might be somewhere along the lines of 4 to 5 days of professional development for every employee each term or year.
   • In his personal experience, he was never audited for professional development. However, he did indicate that an auditing process does take place among teachers regarding professional development.

11) Extended contacts:
   • When getting in touch with pre-service teachers, most of this semester’s schedule is already planned out. The school is short on time as it is already and there is little opportunity to add in additional activities.
   • Dr. Gough was going to look into whether or not we could introduce our project ideas and questions on any of the online classroom websites. If we did, it would be up to the students to take the time and contact us.
   • In the future, with a reasonable amount of lead-time, it wouldn’t be hard to integrate a workshop into the class schedule. The amount of lead-time required is somewhere around the range of a semester before.
   • In terms of the amount of time allowed for a workshop, a 1-hour slot would be likely. This would encompass about 120 students over the course of a week. In a session such as this, he suggested that some extra materials be provided so that participants could follow-up on the on-line classroom environments.
Interview with Tony Watt on 21 March 2007

Dr. Tony Watt is a professor at Victoria University. This interview was performed over the telephone.

1) Background:
   • Dr. Tony Watt has been the Bachelors Education Coordinator for 6 years at Victoria University. He also deals with the education of specialized primary and secondary education teachers pursuing physical education.

2) Presentation of workshop material:
   • Make it context specific so that teachers can make an immediate relationship with the material.
   • Find the right content to introduce the participants to the ideas that identify the fundamental concepts.
   • Using excel is a good way to start. Graphing calculators might be very useful for the mathematics teachers, but it might not be as beneficial with other subjects.

3) Reasons why teachers don’t teach statistics:
   • Teachers often have a hard time understanding that statistics is a tool and get caught up in the analytical portion. They don’t always connect the outcome and application of statistics to the subject.

4) How statistics relates:
   • Uses statistics when teaching teachers specializing in physical education in a couple of ways. First, statistics helps in determining what types of physical activity students like best. Through surveys, he collects the data and develops trends as to which ones work best. He then uses the results from the data to rework the program.
Interview with Susie Groves, Gaye Williams and Brian Doig on 21 March 2007

Susie Groves is an associate professor, Gaye Williams is a lecturer, and Brian Doig is a lecturer of Deakin University.

1) Background:
- Gaye Williams was a secondary school teacher for 25 years covering years 7 through 12. She taught mathematics up to topics covering high-level calculus. She finished her PhD in 2006 in the area of developing creative thought. Since then, Gaye has participated in the numeracy/literacy program.
- Susie Groves has been at Deakin for 32 years involved with primary and secondary education. Has taught in mathematics education units both on and off campus and online. She is also heavily involved with the numeracy/literacy program.
- Brian Doig started teaching as a primary school teacher in Victoria. He then went on to get a degree in mathematics and began training primary education teachers and worked in a research institution for education. Brian is now involved in preschool and primary education at Deakin University.

2) Pre-service statistics requirements:
- At Deakin, pre-service teachers spend part of their time with science and mathematics faculty learning the actual math behind the subjects. The rest of their time is spent with the education department developing an understanding of how students learn.
- In order to be a secondary teacher, there is no statistics requirement. Secondary teachers are only required to have taken some recognizable mathematics course.
- Mathematics courses can cover the ‘how’ of teaching statistics rather than the statistical concepts.
- In the numeracy across the curriculum program, there are a couple of key points that are conveyed. First, the program aims to point out to students that text might include statistics. It also uses media text to show that data needs to be interpreted to see if it is misleading. The program tries to develop this type of critical thinking because teachers often leave out and accept the statistics portion. Second, the program looks at statistics and data that come from schools because quite often, it never gets out of the principal’s office. Teachers need to be able to question the principal. The program also covers how the grade point average (GPA) is calculated (hard subjects are worth more than easier subjects). Teachers are often unaware of these issues and truly need to know this information to prosper in their career.

3) Presentation of workshop material:
- It would be beneficial if pre-service teachers were able to explore and find their own ways of teaching the material rather than ‘throwing it at them.’
- Gaye would be more likely to use it if were an activity rather than a presentation. Also, the review of background material should come during the process as it becomes relevant rather than having it right in the beginning.
- Provide the participants with a purpose. Again, show them the usefulness of the statistical concepts as it comes up.
• The numeracy and literacy program has a duration of 3 hours for each session.
• It is important to give the participants support, especially after the workshop concludes. A workshop should give them a taste of what’s out there. You want to leave the audience wanting to use what you’ve just shown.
• A lot of the excitement comes from what the package or workshop can do. Show the participants how ABS can help.
• It’s really the concepts here that are the important things. The tension lies between the limited time and focusing on the general broad topics/concepts and showing how you can use it. With the limited timeframe however, the students should be doing most of the thinking after the workshop takes place.
• When giving a purpose, get the idea across that there are many topics of discussion and show pre-service teachers how to access those topics. Make the site known to them and show them how to use the data, especially regarding CensusAtSchool.
• For mathematics teachers, present the workshop in a way that says ‘Here’s a way to use real data to present the mathematical concepts.’
• The participants should be aware that everything on the ABS website is free.
• For example, if one of us were a geography teacher, we would need to know the importance of statistics in the subject. Show an example topic that I could use. Show what else is offered out there in terms of resources to explore and use.
• Pre-service teachers cannot assume that there are statistics in a particular subject. Show the relevance between the topic and statistics.
• Another big point is that the audience wants to know how they can use it as a learning process and not just an activity.
• Mathematics teachers need to see how statistics can be applied and where the major subjects and concepts come from.
• Non-mathematics teachers need to realize that the workshop is a tool for teaching geography, not a tool for teaching geography with statistics.
• In terms of an audience, pre-service teachers in their final year are often very busy. The focus might be on pre-service teachers in their second to last year.
• Depending on who is attending, modify the jargon for each audience if it is comprised of specific subjects. Otherwise, keep the wording rather general.
• Overall, including curriculum development isn’t the best idea. Teachers often need time for incubation and thought. It might be appropriate to show a sample of what they can do however.
• When teachers begin to interrogate the data, the questions should come naturally. When providing interactive examples in a workshop or classroom setting, the presenter does not necessarily need to go to the end. As long as the teachers understand how they got there, realize where they could go with the idea, and feel comfortable recreating the experience on their own.
• Incorporate the use of technology only when it becomes useful, much like the background information. Introduce it in quick segments as a reference for further exploration so as not to interrupt the flow of the lesson.

4) Reasons why teachers don’t teach statistics
• Teachers often feel anxious about mathematics or think that it is none of their concern.

5) Cross curriculum application of statistics:
• -
6) Curriculum development by pre-service teachers:
   • -

7) Cross curriculum programs:
   • -

8) Motivating pre-service teachers to attend the workshop:
   • -

9) Innovative ways of teaching:
   • -

10) Professional development requirements of teachers:
    • No formal requirements exist. PD requirements usually depend on the school and how much funding is budgeted for PD workshops.

11) Extended contacts:
    • E-mail contact information for dissemination to students.
Interview with Deirdre Casey, Andrew Stewart and Anne Starkey on 21 March 2007

Deirdre Casey, Andrew Stewart and Anne Starkey are teachers at Presbyterian Ladies College (PLC).

1) Background:
   - Deirdre Casey teaches mathematics at the year 8 and year 12 levels.
   - Andrew Stewart has been teaching the statistics course at PLC for 14 years now.
   - Anne Starkey teaches biology.

2) Statistics comfort:
   - Anne feels comfortable with general statistics. She states that she often uses standard deviations in her biology classes.
   - For students attending PLC, may or may not be directly exposed to statistics depending on the courses they take.

3) Approachability of statistics:
   - Use relevant examples.
   - Be non-traditional when presenting statistics.
   - Make the data visual by using graphs. It is often easier to see the concepts as a graph or visual representation rather than raw data.
   - The courses in year 9 are required to have graphing calculators so that students learn the process and results rather than the fundamental calculations.
   - Emphasize the significance of statistics and then focus on the process.
   - Use interesting topics to match data to and discuss with. For example, ‘dreaming vs. non-dreaming mammals in Australia.’

4) Using statistics in the classroom:
   - For biology, T tests correspond to field data such as the affect of different fertilizers on dandelions. Statistics is also used in determining if the variation in breeds shows a large enough deviation to declare a new breed. A lot of statistics are found in ecology.
   - The significance of terminology is explained to develop better literacy in the subject.
   - One example of showing the effectiveness of sampling included an analysis of IQ vs. gender. Small and large samples were collected and the variation in the data sets was observed.
   - Spreadsheets were used occasionally however the teachers found that graphing calculators were much quicker to use in lessons. Instead of renting out the computer room, the graphing calculators presented a convenient way of displaying data.
   - Thoughts on why teachers might not use statistics in the classroom included talk about the lack of exposure at universities and during school years. They also felt that perhaps a long period of time had passed since they were last
exposed to statistics or either they had a bad experience at some point in their education associated with statistics.

5) Suggestions for the workshop
   • Again, make the discussion relevant to the particular subject it’s trying to reach.
   • Ask them if they are aware of statistics in their subject.
   • Keep it interactive. Include parts that are active and require teaching rather than having them sit back and soak up information.
   • Present numbers and pose questions. Use relevant data sets for each particular subject.
   • Point out the statistical concepts and how they apply to the subject. Highlight the benefits of using them to enhance the students’ knowledge of the subject.
   • Background sections on statistics will probably be necessary to help remind the participants of statistical concepts.

6) Gender neutral statistics activities:
   • Weather works well and can be used for multiple subjects.
Interview with Yvonne Lane, Erin McInerney, and Irena Glac on 23 March 2007

Yvonne Lane, Erin McInerney, and Irena Glac are teachers at Bentleigh Secondary College.

1) Background:
   • Yvonne Lane teaches mathematics at year 11.
   • Erin McInerney teaches mathematics and science at year 10. She is currently in her chemistry unit.
   • Irena Glac teaches physics at years 11 and 12.

2) Statistics comfort:
   • They all believe that they are comfortable with general statistics concepts.
   • Teachers are sometimes confused when determining the best time to use certain statistical concepts, especially with central tendency (mentioned mean, median, and mode).

3) Approachability of statistics:
   • Children can become confused with the technical examples in the textbook. You want to present data that is relevant to them.
   • Erin finds that statistics isn’t difficult to teach as long as you associate the subject with activities. As long as it is presented in that way, the students understand the concepts more effectively. Also, having students ask themselves if the data presented represents a decent sample is a good way of getting them engaged.

4) Using statistics in the classroom:
   • Irena mentioned that she does not do any statistics in physics; she only collects data to get reliable results and said, “…That’s just a part of the course. Just common sense. We don’t call it statistics.”
   • Erin uses statistics in titration exercises while teaching chemistry.
   • Excel is used in junior level mathematics and graphing calculators are utilized regularly as well. Graphing calculators are required for years 11 and 12.
   • Kids also have a difficult time transferring one concept used in excel to using it in a graphing calculator.
   • There is a big push on integrated units in VELS. An integrated unit is a project done in multiple classes. For example, students learn concepts and formulas in their mathematics courses and then go into their science classes and use those formulas to collect data and analyze it. Finally, they go to their English classes and learn how to properly present the data with written word.
   • At this school, statistics is not a subject that gets pushed to the end. The school year often starts with statistics.

5) Suggestions for the workshop
   • Workshops focused on excel and graphing calculator usage would be beneficial. They also mentioned wanting procedures on how to get data off of the ABS website.
• Provide notes on the function of the technology and how to use it.
• Sitting and listening at a workshop is a big turn-off. A workshop should provide participants with something to take back.
• Integrated units can sometimes be difficult to start. Some sort of guidance on how subjects can be integrated would be very useful.
• Teachers would also really like either a pre-written unit or at least some ideas to aid in creating their own units.
• They find that they often do not have the time to write integrate units and would have to accomplish such a task while on holiday, but no one truly likes that idea.
• There have been no strict professional development requirements established yet, but they are certain that at their school each teacher needs a certain amount of hours outside of school time.
• They attended a workshop on using the TI-84 graphing calculator where an instruction booklet was provided along with new material, methods, and programs. The instructors of the workshop were also available for further questions. They believed that this workshop was very helpful.
• There are annual subject specific conferences for teachers that are always looking for speakers or workshops. Those might be a good way to get this out to teachers.
• The workshops at these conferences can range from 2 hours to all day.
• Another tool that attracts teachers is something that is useful, relevant, and free.
• The more relevant examples of application you provide to teachers, the better.

6) Gender neutral statistics activities:
• To make it gender neutral, the presented data needs to be relevant. If a data set were being presented to year 10 students, then perhaps the example would have something to do with car accidents seeing as they are all just getting their licenses.
Interview with Rosemary Callingham and Jane Watson on 27 March 2007

Dr. Rosemary Callingham is a senior lecturer of the University of New England (UNE) and Dr. Jane Watson is a professor of The University of Tasmania (UTAS).

1) Background:
   • Dr. Rosemary Callingham is a senior lecturer within the School of Education at UNE, which is located in Armidale, New South Wales. She is a member of the Mathematics/Science/Information Technology/PDHPE Teaching and Research Group (TRG) specializing in mathematics education. Her qualifications include: PhD, MPA, MEdStud, BSc (Hons).
   • Dr. Jane Watson is a professor of mathematics education at UTAS, which is located in Hobart, Tasmania. Her recent teaching experience I associated with mathematics content for primary teachers, and curriculum and method courses for primary, middle school, and secondary mathematics in the Bachelor of Teaching program. Delivery of professional development in chance and data for the Quality Teacher Program has also been carried out in the past three years.

2) Pre-service statistics requirement:
   • You can treat pre-service teachers as educated but uninformed. You need to push/lead them to explore the points of the workshop.

3) Presentation of workshop material:
   • Most pre-service lecture models are based around 2 hour time slots. Your best bet is to develop the workshop to last about 2 hours.
   • Put a boundary on the scope of the workshop and specifically define the subjects you are truly aiming at. Regardless of what subjects the workshop includes, it needs to be clearly identified that the workshop is for everyday teaching.
   • When having participants brainstorm ideas about how statistics applies to their subject, they might mention topics such as graphs, average rainfall, etc. Whatever they mention will ultimately dictate the topics to be included in discussing relevant statistical concepts and application.
   • Providing insight into how statistical requirements exist in specific KLA’s is a useful tactic. That provides a perspective that often gets overlooked.
   • The overall idea and structure of the group activity is good, however time might become an issue. There might be 25 – 30 minutes for participants to split up into groups and develop an activity.
   • Pre-service teachers can’t always produce an activity on the spot. They often require some cues or direction to spark their creativity.
   • To cope with the time issue, you might want to consider providing the lecturer with an assignment to hand out before or after the workshop. This assignment would focus on developing or expanding on the activity portion of the workshop.
   • Come with three different data sets and split the participants into three groups corresponding to the nature of each data set (mathematics pre-service teachers...
with mathematics data, science pre-service teachers with science data, and social studies pre-service teachers with social studies data set). From there you can assure that participants are dealing with relevant data. Once you bring the three separate groups back together, everyone gets to see the cross-curricular nature of statistical application.

- You want to provide material and data sets that aren’t too complicated, but provide the math and science people with data that they can play with (raw data) and the social science people with summary data.
- Make sure that you have a ‘leading structure’ in place for the activity. Lead the participants through a successful statistical process, i.e. data collection, survey (be careful and keep the conversation about surveys to a minimum), analysis, summary, and conclusion (this includes the proper representation of conclusions as well as the confidence behind the results).
- Look at the approach that New Zealand takes to interpreting data. Using the idea of problem, plan, data, analysis, conclusion for a structure might be a great way to approach the first part of the workshop because it is a rather generic cycle. With this approach, instead of discussing mean, median, and mode, have them brainstorm what the kids will need to know at each stage of the process.
- In terms of regrouping everyone after developing their activity, it might not be possible to have everyone reflect on what they learned. It would be more feasible to have each of the three groups come to a consensus as to what was learned through the process and report back to the rest of the audience.
- Make sure to explain the rationale of including certain ideas and activities when pitching this to both pre-service teachers and lecturers.
- Provide handouts of the statistical requirements contained in the VELS for each KLA.
- Make it obvious to the participants that kids are usually told what to do and are often not encouraged to ask the questions. This process will help them begin to critically analyze and question data of all kinds.
- Because the data set will be provided to the participants, there should be some section in the workshop that visits questioning data gathering methods. Discussions on how sampling gets conducted must also be present.
- Introducing the workshop halfway through a program will allow time for lecturers to add material into the curriculum afterwards to help reinforce the points the workshop conveys.
- Be prepared to encounter questions regarding the assessment of programs by the school. For this, discussion on how the activity fits into the VELS might satisfy that query. Discussion regarding assessment can get rather lengthy and it would be best to keep it short. Most of the time, secondary schools have assessment methods in place already, but it is good to make them aware of the topic.
- Be careful about presenting the workshop as a new way to teach. It is more of an exercise that provides pre-service teachers with an investigative approach that focuses on the statistical literacy involved within their subject.
- When reporting back near the end of the workshop, each group might focus on certain aspects of the problem-conclusion cycle, however each group needs to be aware of the full cycle so that the students can benefit.
- Science teachers are often focused on planning experiments. Look into including the reaction-time program as part of the activity exercise for the
science group. This would let them do an experiment, collect data, and then compare with the ABS data set on reaction times.

- Kids really like data that is personal and applies to them. They also like to compare their personal data with larger sets. In an even more general sense though, when looking at data, people tend to start with their own community and then branch out to other communities to compare.
- The science group might focus on steps 1 and 2, the mathematics group might focus on steps 3 and 4, and the social studies group might focus on steps 4 and 5. When regrouping the participants, pointing this out might help support the idea that students experience the entire cycle over the curriculum. This is a great way to link concepts and disciplines together.
- In the beginning of the workshop, think about bringing up discussion regarding statistical literacy. A flashy, quick introduction of newspaper articles with examples of statistical applications is an effective tool to get the audiences attention. Google “numeracy in the news” for examples of everyday articles that contain statistics.
- Pick out a few really interesting articles to act as a starting point for the workshop. Possibly include these articles as a handout. Including an article about their town shows a personal connection.
- Overall, the usage of statistics will be slightly different from subject to subject, but the goal and process stays the same.
- Provide a series of structure questions pertaining again to the problem-conclusion cycle.
- With technology integration, get the pre-service teachers to ask themselves how certain technology will support the issue at hand. For example, how will plotting the data on excel enrich the understanding of the subject by the student?
- Make sure to look at the chosen lessons when creating the workshop and critically determine the possible terms and uses of technology associated with the discipline. For example, the social studies group might look at what’s produced and why. They could use Google Earth to show the dispersal of products on a map.
- Provide the pre-service teachers with handouts that are particular to the day’s activities and websites for the rest of the resources.
- Identifying the specifics of each subject and how it fits into the workshop setting will allow a generic workshop, a math, science, soc. Workshop, a math/science, soc. Workshop, or individual workshops.

4) Extended contacts:

- Send a copy of the workshop to Jane and Rosemary.
- Australian Mathematics Teachers: Work with Rosemary to get the findings and workshop published.
- Teaching Australia is attempting to develop a national standard that might encompass an effort such as this.
Interview with Neville Davies and Doreen Connor on 28 March 2007

Neville Davies and Doreen Connor are members of the Royal Statistical Society Centre for Statistical Education (RSSCSE).

1) Background:
- Professor Neville Davies served as a professor at the Nottingham Trent University Clifton Campus but is now the director of the RSSCSE. Doreen Connor is the CensusAtSchool coordinator within the RSSCSE.

2) Pre-service statistics requirements:
- In terms of knowledge, you can’t assume anything.

3) Presentation of workshop material:
- Know the background of the audience. Ask what their level of knowledge and confidence is with statistics and get an idea of the kinds of experiences they’ve had with statistics. You really want to get a good idea of whom you are dealing with before you pose the question of “how does statistics apply to your discipline?”
- You also want to figure out what kinds of variables you want for the data you present to the teachers. Chat with pre-service teachers about what they would find interesting. Find out what would motivate them. When you find that, then you can figure out the appropriate data set to pull from the CensusAtSchool data.
- What the workshop is really looking at is ‘data production.’
- Get the pre-service teachers to realize that there’s a problem regarding interpreting statistics. A good example of an icebreaker activity that pertains to that is getting participants to fill out a confidential survey, then having them pair up and interview each other with the same questions, and then do a group survey with raised hands. Collect the results afterwards and the results tend to vary a lot depending on how you collect the sample. This helps to illustrate planning and data collection.
- The basic idea is to get people to start questioning. Showing a data set and getting them to question it is a good way to build that type of behavior.
- Again, show them that a problem exists and that statistics is a thinking subject. The big picture is that statistics is a tool for problem solving.
- Provide them with alternatives to just excel and graphing calculators for developing and solving statistics problems.
- Don’t split up mathematics from non-mathematics when asking, “how does statistics apply to your discipline?” Mathematics teachers don’t always know that let alone how it applies to other subjects.
- Bring in data or statistics from the news. That way they might have come across it recently.
- Concentrate on a couple of good bits of data and allow the group to have fun with it. You don’t want to swamp them with too many ideas, just the essentials.
- The idea of holding a lesson plan activity is good.
• Be prepared to reference the VELS, particularly with how statistics applies to certain subjects. Doreen mentioned that her students often pose that question.

4) Reasons why teachers don’t teach statistics
• -

5) Cross curriculum application of statistics:
• Neville – “The goal of statistics is to get information from data. If you want to know what data is, then data is numbers in context.”

6) Curriculum development by pre-service teachers:
• -

7) Cross curriculum programs:
• -

8) Motivating pre-service teachers to attend the workshop:
• -

9) Innovative ways of teaching:
• In terms of recognizing good lesson plans from bad lesson plans is a personal preference. Doreen expressed that she preferred lesson plans that go backwards where questioning a data set occurs rather than providing a data set and dictating where it needs to be taken. Backwards lesson plans allows participants to think and argue.
• On the UK website, there is an activity called ‘Dirty Data.’ The activity presents about 30 rows of data that contain inconsistencies and poses the question, ‘what are you going to do with the data?’ Have each group try to interpret the meaning of the inconsistent data. This helps support the idea of looking at the data to see if it makes sense. This type of activity reminded Doreen of the NASA quote that went something like, “The problem wasn’t with the error. The problem was that nobody spotted it.”

10) Professional development requirements of teachers:
• -

11) Extended contacts:
• Take a look at Stats for Schools on our site. Those plans get a lot of hits. Also check out the Statistics Canada site for material and ideas.
• Take a look at the curriculum worksheets on the UK CensusAtSchool website. Those provide good resources.
Interview with Andrew Mangonis and Marilyn Faithfull on 29 March 2007

Andrew Mangonis and Marilyn Faithfull are both teachers at Koonung Secondary College.

1) Background:
   • Andrew Mangonis is a maths teacher at Koonung Secondary College.
   • Marilyn Faithfull is a maths teacher at Koonung Secondary College.

2) Statistics comfort:
   •

3) Approachability of statistics:
   • Teachers are discouraged from statistics due to confidence and their familiarity
   • Stats are seen as a lowest reign math. It’s the most expendable. It can be pushed to year 10 or year 11.

4) Using statistics in the classroom:
   • Every teacher teachers statistics differently.
   • Used the ABS website, got kids to design different worksheets. Used a random sampler and showed how graphs can be misleading. Kids enjoyed the activity because they completed the C@S survey online and they could relate to the data.
   • Both teachers are frustrated with technology, because it is not intuitive. For example: excel graphs well, but there is difficulty with everything else.

5) Suggestions for the workshop
   • Have a creative name for the workshop
   • For kids to calculate the mean, line everyone up and find the median, mean, and mode. However, people can be sensitive to weight and height.
   • Need a discussion for the participants to be interested in the subject
   • Simple ideas are the best
   • Putting excel into the workshop would recommended
   • Having a self paced statistics course using graphing calculators with personal data would be helpful

6) Gender neutral statistics activities:
   • Reaction times are gender neutral
   • Gummy worms, measure lengths from random starting lengths
   • Competition is good
   • Loaded double barrel questions are interesting
Interview with Anita Forsyth on 29 March 2007

Anita Forsyth is a professor at Monash University, Clayton Campus.

1) Background:
  • Anita Forsyth is Senior Lecturer from Monash University. She began with teaching at secondary schools for 15 years and then came to Monash University in the 1980’s. She works with secondary level pre-service teachers in business, economics, and social studies. Anita also works as a school principal mentor and school inspector. Anita was also heavily involved in the initial development of the VELS and was a major contributor to writing the economics standards within the document.

2) Pre-service statistics requirements:
  • There is an uneven dispersion of statistical knowledge and people might lack confidence with statistics or perhaps they have had a bad experience or little exposure to the subject. Either way, you want to start of small in the session. Perhaps the workshop could be split into two sessions, a foundation and advanced session.
  • Appreciate the variation of pre-service teachers. They come from many different backgrounds and often don’t have the same experience from one to the next.

3) Presentation of workshop material:
  • Anything more than a 2-hour program would be too much.
  • There are a variety of ways to approach this. One way is to do the workshop with an online follow-up. For example, someone comes and facilitates and perhaps at the end there is some sort of online competition with prizes or incentives.
  • Stress to the pre-service teachers that there is a clear need for accessing data that’s relevant for teachers of subjects based on the research that ABS has done. If the teachers want to do any kind of research, they can look at and use the ABS data. Statistics is able to provide the evidence from the raw data to help support the hypothesis.
  • Also, stress the idea of interrogating the data. You want the teachers to question.
  • Inform the pre-service teachers about what’s on the ABS site first before having them engage in activities.
  • Providing examples of raw data or material and then asking how it would be used to teach a lesson is a good activity.
  • In terms of using graphing calculators, ¾ of them might not have had experience with the technology in quite a long time. It might not be the best thing to do in the workshop.
  • Dictate to ABS the necessary questions that need to be asked in order to run an effective workshop. For example: Is a lab room necessary? What kind of equipment is available in the presentation room? Etc. Essentially the recommendations should be something like “here’s what we have, here are the relevant questions needed to take the workshop to the next level”
• The audience size for a workshop like this, if at all possible, should be somewhere around 25.
• This workshop could also help teachers understand the reasoning behind the process that the data on the ABS website goes through. If they understand that then they might be more inclined to use it to improve their teaching.
• Provide examples of teaching and learning and how it applies to their subject. Also, show a case study that they could develop a lesson plan or report activity from.
• Provide the teachers with an idea of what the project is trying to accomplish.
• Statistics is not specifically identified in of the social sciences courses.

4) Reasons why teachers don’t teach statistics

5) Cross curriculum application of statistics:
• The VELS try to show how economists think and develops the statistics and nature of research that go along with an economic process. VELS is big into creativity, inquiry, and data collection.
• For economics, topics that are often discussed are inflation, unemployment, and GDP. From these they learn how to read charts, trends, data, etc.

6) Curriculum development by pre-service teachers:
• It would be best to get this workshop to 4th year students at Monash University. 4th year students have 12 weeks of classroom experience and something like this would be great to expose them to after this period of study. The beginning years at Monash deal with the psychology of teaching and might not run parallel with the aim of the workshop.
• The structure of the degree system would put 4th year students into two groups. Post-grad students that got one degree or final year students that went for a double-degree. The best idea would be to talk with the faculty and lecturers to apply this in 4th year lectures.

7) Cross curriculum programs:

8) Motivating pre-service teachers to attend the workshop:
• The more information that you provide about the workshop you’re offering, the better received it will be by pre-service teachers.

9) Innovative ways of teaching:

10) Professional development requirements of teachers:

11) Extended contacts:
• Approach the course coordinators after the final product is completed in order to pitch the inclusion of the workshop into the school.
• One program that you might want to look at is AusTrade, an effort that developed material for pre-service teacher regarding the transference of goods
from one nation to another. The contact for this is Leigh Derigo. Another contact is Dianne Boase of Global Educators of the Geography Teachers Association Victoria. The focus of this association is globalization across the curriculum.

- When presenting this to the VCAA, show how statistics can illuminate the curriculum. Also, include a written vision and mission to help show the rationale as to what this workshop wants to do. Then what you want to do is develop a plan of action for implementing the workshop. In terms of people you want to go to, talk to state authorities if you want to influence the education portion. Currently, there isn’t all that much that you can do. The best idea is to figure out what it is that you want to do and give ABS a heads up about how the action plan should unfold, i.e. a timeline of events that need to happen in order to influence education standards with the workshop.
Interview with Mara Rebellato on 29 March 2007

The interviewee was Mara Rebellato of the Australian Bureau of Statistics (ABS) CensusAtSchool project.

1) Background:
   • Mara worked as a teacher consultant in 2006 for ABS and conducted professional development courses around the country to promote the CensusAtSchool project.

2) Pre-service statistics requirements:
   • -

3) Presentation of workshop material:
   • Be careful with the phrasing of the questions throughout the workshop. The idea is to have a clear-cut document for the entire workshop. You want as little interpretation by the proctor in order to get a consistent outcome.
   • Showing statistics in society is important, but where that kind of showcase takes place within the workshop should be strategic. The bottom line is to make the workshop flow.
   • Ask the pre-service teachers if they know that there are statistics in VELS before showing them. Once you do show them, they should realize that what they are supposed to be doing in class does directly apply to statistics.
   • When presenting any kind of data to the pre-service teachers, you need to make sure that it either has strong connections to their discipline. For example, in social studies, pick something like the drought and provide some raw data relevant to that. Ask them how they could take that data, bring in the VELS and concepts of social studies, and create a lesson. That’s the idea of having strong and deliberate connections.
   • Pick the data sets you intend on showing the pre-service teachers very carefully.
   • Another good tactic is showing where the statistics are in a subject and developing ways of drawing those statistical concepts out to create a lesson.
   • Talk about resources, teaching methodologies, and aspects of topics that kids respond strongly to.
   • If there were multiple disciplines at the workshop, then break down into subject specific groups and think about the thinking cycle that students go through. When you compare mathematics to science to social studies and so on, the teachers should see that there is a strong connection between the process of developing a solution to a problem.
   • With such a small amount of time, everything needs to be based on the core goals that the workshop needs to achieve.
   • Don’t get them to write too much down. Jotting ideas down should be the most they will have to write. You want them to discuss and hold conversations more than anything.
   • Have the pre-service teachers indicate where the statistics are. From there refer to the VELS and say that you need to think a little bit more about the
standards. Then bring up the notion that there are some resources on ABS that can help them with achieving that.

- Be careful with showing the statistical concepts in a particular subject. That’s the brunt of the core statistical knowledge. Approach it in the manner of “students should be able to … by the age of…” rather than lecturing about mean, median, and mode.

- A good exercise is to ask them to define a statistical term like the mean. You are bound to get a lot of different answers, and when you do, make it clear that everyone has a different understanding of terms and that your students will be in the same boat. This can then be used to discuss how a lot of concepts get used for different reasons, which lead people to have different understandings of the subject.

- The pre-service teachers should be aware of the statistics in whatever subject they teach in order for them to feel comfortable teaching it.

- Make sure to have pre-made answers in order to provide suggestions when a question stumps the audience.

- A good start to understanding the terms that exist in certain subjects is looking at the VELS. Go through those and pick out the key terms that relate to statistics.

- Make the lesson activity very clear and relatively brief. Pose a question such as “how could you make a lesson around statistical concepts?”

- In terms of assessment, the pre-service teachers might be inclined to ask about student assessment. In order to review progress concerning statistics, the correct answer isn’t nearly as important as the process. Having students explain what they do will pull back and reinforce the thinking cycle. Also, if it’s in VELS then you have to teach children about it. If you have to teach it, then the teachers have to assess it. If they have to assess it, then they have to utilize that thinking cycle. You want to stress this point and provide examples of how it’s used.

- The different parts of the workshop can really vary in duration. If you needed to cut something short, it would be part the introduction section. You want them to have enough time to think about and discuss pulling the statistics out of a pre-existing lesson.

- A good idea might be to look at textbooks or VELS to see good practices or lessons that they might actually use in the classroom. That would be a good way to get some really relevant examples. From that, the workshop can have them pull the statistics out of an activity or project that they were more than likely going to have to do in the classroom.

- The basic idea is to provide a topic or data to the teachers and have them pose questions pertaining to gaining a better understanding of what the topic means or data represents.

- A good tactic is figuring out exactly what it is that the teachers are supposed to teach in their subject. Again, a good starting point for this is the VELS.

- Three distinct groups come to mind: Mathematics/Science, English/Social Studies, Health.

- Don’t conduct a high and low level statistics course at the moment. This should come after trial runs take place. The best tactic is to show that professional development courses and training exists already to help foster any technical statistics questions and that the ABS provides free resources that can help.
• A general process would be finding what they need to teach, showing them a subject or activity that they need to teach, having them draw the statistics out of that subject and come up with an activity with those statistics, and finally showing them the free resources that can help aid them in gaining a better understanding of the material.
• An interesting activity might be providing a section of the VELS and asking them to find the statistics in it and see if it matches up with what ABS found.
• Mentioning other resources, such as TinkerPlots, Phathom, getting an expert in, etc., could be helpful.
• Make sure to give away as many freebies as possible. Anything with ABS, contact numbers, or e-mail addresses are helpful.
• Provide a 1-page summary and the CensusAtSchool flyer as well. Suggest that they put this material into their resource kit and also keep the highlighted VELS sheet in case they need to reference it again.

4) Reasons why teachers don’t teach statistics
• 

5) Cross curriculum application of statistics:
• 

6) Curriculum development by pre-service teachers:
• I would be inclined to present this workshop to final year students. That’s when they really start to experience and understand what goes into teaching students. I think the workshop would be more received by that audience.

7) Cross curriculum programs:
• 

8) Motivating pre-service teachers to attend the workshop:
• 

9) Innovative ways of teaching:
• 

10) Professional development requirements of teachers:
• 

11) Extended contacts:
• 

# Appendix D: Interview Contact List

## Universities

<table>
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<tr>
<th>Affiliation</th>
<th>Contact(s)</th>
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## Schools

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## Members of Statistical Organizations

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Appendix E: Workshop Facilitator Presentation

Dealing with Data
Conn Dickson
Ben Dwyer
Andrew Lingenfelter

Beginning of the Workshop (~1 Minute)

- Introduction of facilitators/ Getting to know your audience:
  1) Introduce yourself to the audience.
  2) Ask to see what disciplines are included in the room if it is not already known.
  3) Following that, explain the expected outcome of the workshop. This statement should include:
     a) We will have worked together to develop an easy way to effectively enhance a student’s learning experience in your discipline by using data.
Brainstorming the Importance of Data in Society (~3 Minutes)

- **How data applies to society:**
  1) Have participants brainstorm ways data is important to society.
  2) As they brainstorm, write down their thoughts on the board.
  3) The outcome of the brainstorming session is the generation of a list of their perceptions of data and its application to society. This activity serves as a gentle transition for the audience to begin thinking about data.
  4) Key reasons that should come up in the brainstorming session are:
     a) To make intelligent decisions or arguments
     b) Use in the job market
        i) For research
        ii) For corporate decision making
     c) Interpreting the media and news
     d) Interpreting advertisements
        i) For products
        ii) For services
  5) After time has been taken up or ideas begin to repeat, close the session. The closing statement should focus on the ideas that:
     a) Data is regularly encountered in society.
     b) Data serves an important role in communicating information in society.
Demonstrating the importance of statistical literacy in society: Discussions using article 1 (~5 Minutes)

• Data Analysis News Article:
  1) The objective of this activity is to show that statistical literacy is important in interpreting and understanding the media. Use graph example provided.
    a) Explain the background of the article:
       i) Its title is ‘Longer Hours and Less Leisure: We’re a Nation of Workaholics.’
       ii) This article is about Australian men and women experiencing an increase of time spent at work.
       iii) The graphs were created using reliable data from ABS.
    b) Have participants review the graphs on page 2 of their packet. They should:
       i) Make note of their first impressions of what the graph is telling them.
       ii) Compare the two graphs and decide if their first impression reflected what was being displayed.
       iii) After 2 minutes, if everyone is finished, move on. If not, allow an additional minute.
    c) Discuss the graphs. The outcome of the discussion should be an understanding of the implications of graphical representation and how that could affect the reader’s perception of the data. That should also help build awareness of why the media might portray data in suggestive ways.
       i) Key points that should be brought up during the discussion are:
          (1) First impressions of the graphs.
          (2) Issues and problems with the scaling.
          (3) How scaling can affect the message the graph initially conveys.
          (4) When placed directly next to each other, it can be misleading
          (5) The female graph looks like it peaks higher in 1994, but it actually peaks at 8% while the male graph peaks at 27%.
          (6) The person who did this may have wanted to make it seem that women were working as many hours as men.
    d) After time is up or all points have been covered, close the discussion. The closing statement should indicate that:
       i) Being aware of how data is presented is a very important skill.
Demonstrating the importance of statistical literacy in society: Discussion using articles 2 (~5 Minutes)

- **Data Analysis News Article:** This activity will show that statistical literacy is important in questioning data collection and sampling methods. Use the provided article.
  1. Explain the background of the article:
     a) Its title is ‘Beware the Pushy Fish-eater.’
     b) This is a short article about a British researcher’s findings relating success with eating fish.
  2. Have participants read the article on page 2 of their packet. They should:
     a) Make note of their first impression of the article.
     b) Think about the results presented in the article.
  3. If everyone is finishes after a minute, move on. If not, allow an additional minute.
  4. Begin to discuss the article. The outcome of the discussion should be a general understanding of how sampling can drastically impact the outcome of a survey. The participants should realize that questioning sampling and collection is an important tool in discovering unethical approaches in representing data.
  5. Develop key concepts that should be brought up during the discussion:
     a) First impressions of the article.

(Continued on next slide)
Demonstrating the importance of statistical literacy in society: Discussion using articles 2 (~5 Minutes)

a) Inquire if they have seen results in advertisements such as the ones in this article. Were they convinced by those results?

b) The actual sampling of the study. 250 surveyed (half men and half women), 6 men indicated that they ate fish regularly. Of those 6, 4 indicated that they felt they were more successful than others. Overall, \( \frac{4}{6} = 0.67 \approx 0.7 \). The study was conducted by John West Foods, a large supplier of canned fish and seafood.

c) Political, social, and ethical reasons for presenting data in such a way.

6. After all points have been made or time runs out, close the discussion. The closing statement should indicate that:

a. Questioning is a critical skill to have in order to evaluate a survey or study.

b. There are ethical concerns involved with this article, and questioning the results in any study can be extremely helpful in making educated decisions.

c. Questioning is a very important skill for children to be exposed to at an early age. The more they question the data or problem, the deeper an understanding they’ll have.
Understanding the Importance of Data in the Classroom (~10 Minutes)

- **KLA Standards Activity:** The objectives of this activity are to build awareness of the requirements that deal with data for each KLA and show that data topics are cross-curricular in nature.
  1. To establish the audiences background experience with the KLA standards:
     a) Find out which participants are familiar with the standards for the KLA they are planning on teaching.
     b) For those that raise their hands, find out what subject it is that they plan to teach and whether or not the use of data necessary to meet the KLA standards.
  2. Whether they each answer yes or no, lead them into the rest of the activity.
  3. As a disclaimer, note that the KLA standards being passed out only cover Level 5 (Years 7 and 8).
  4. Have the participants look at the standards handout for their discipline. As they read through the article, have them find and highlight any sentences, terms, or concepts that they believe might relate to data some how.
  5. After 5 minutes have passed, ask to see what terms they found and which subject they plan on going into. This will help later in showing that data is used across the curriculum. As they indicate which terms they found, write them down on the board, group them according to the following headings (Note: do not write the headings until after the participants begin to provide terms):
     a) **Data**
     b) **Collect:** Terms can include sample, gather, collate, etc.
     c) **Organize:**
     d) **Present:** Terms can include table, spreadsheet, chart, graph etc.
     e) **Analyze:** Terms can include evaluate, interpret, predict, reliability, conclusion, experiment, problem, hypothesis, plan, etc.
  6. Ask them where those concepts would come into play when discussing topics or doing activities in their discipline.
  7. Close the activity. The closing statement should include:
     a) Data has a significant place in the classroom.
     b) Data concepts are used across a variety of disciplines.
     c) The link that data has across disciplines makes it a great tool to link subjects when coordinating cross-curricular projects.
Developing the Scope of the Problem (~1 Minute)

- Introduce the problem: The objective of this section is to show what the problem is. Points in this introduction should include:
  1) Teachers often avoid the use of data in their classroom activities.
  2) The cause of this is often due to
     a) A lack of using data on a regular basis.
     b) Being uncomfortable with using numerical data (statistics).
Developing the Solution to the Problem: Introduction (~1 Minute)

• **Outline the upcoming activities:** The objective of this section is to show that there is a solution to the problem. In stating what the solution encompasses, include:
  1) Developing a universal method that:
     a) Effectively deals with data
     b) Is easy to bring into an existing classroom activity
     c) Can be used to create classroom activities
     d) Is easy to use, therefore promoting confidence
Developing the Solution to the Problem:  
**Introducing the Statistical Enquiry Cycle (~1 Minute)**

- **Introduce the Statistical Enquiry Cycle:**
  1) The universal method that can effectively deal with data: the PPDAC cycle.
  2) The cycle serves as a great resource for creating lessons plans that incorporate the use of data in the classroom.
  3) Although some disciplines may put more focus on certain parts of the cycle, it is important for all disciplines to consider each step.
  4) See page 3 of your packet to see this.
Developing the Solution to the Problem:
Introducing the ‘Problem’ Step (~1 Minute)

- Address the audience:
  1) The problem step is all about understanding and defining the question.
  2) When thinking about the problem, you want to keep in mind questions such as:
     a) What needs to be known to answer the question?
     b) Is the data relevant to the question?
  3) By the end of this step, you should be able to make an hypothesis or statement of what you
     would like to prove
  4) Ask audience why this step is important
     a) If you do not have the proper question defined, you will not get the right answers
Developing the Solution to the Problem: 
*Introducing the ‘Plan’ Step (~1 Minute)*

- **Address the audience:**
  1. The plan step is all about organizing how you will tackle the problem.
  2. When thinking about this step, you want to keep in mind:
     a) The design of your study
     b) Sample sizes
     c) How you will collect your data
     d) The type of data that’s being collected.
  3. By the end of this step, you should have a solid methodology developed with a clear set of goals.
  4. In the “Pushy Fish-eater” activity, the plan step was faulty, because the sample size was much too small.
  5. Ask audience why this step is important
     a) Failing to address this stage will result in faulty data collection, skewing your results.
Developing the Solution to the Problem: 
Introducing the ‘Data’ Step (~1 Minute)

- **Address the audience:**
  1) After collecting data, you need to have the data organized
  2) The data step is all about managing and organizing the data that was found from conducting the plan step.
  3) After completing this step, the raw data should be in a form that’s easy to use for analyzing.
  4) Ask audience why this step is important
     a) Failure to address this step can result in mistakes in your analysis.
Developing the Solution to the Problem:
Introducing the ‘Analysis’ Step (~1 Minute)

- Address the audience:
  1) The analysis step is about processing and displaying the data.
  2) When displaying the data in tables or graphs, it is always good to be aware of how it’s presented.
     a) Do I have the proper axes?
     b) Is this the best display method for the set of data?
  3) By the end of this step, you should be able to see any patterns and characteristics in the data.
  4) Ask audience why this step is important
     a) Improper representation of data
     b) Failure to address this step properly will result in a faulty conclusion
Developing the Solution to the Problem:
Introducing the ‘Conclusion’ Step (~1 Minute)

• Address the audience:
  1) The conclusion step is where everything comes together.
  2) This is where you look at the patterns and characteristics of the data and interpret them to make a conclusion about your original question.
  3) In this part, it is absolutely necessary that the proper terms are used to effectively communicate why and how you reached your conclusion.
Developing the Solution to the Problem: Demonstrating the PPDAC cycle (~10 Minutes)

- **Problem Step**
  1) The problem step is all about understanding and defining the question.
  2) Normally, you would ask the question first, and then find the best method of acquiring the data.
  3) We have a reliable data set, so we’re going to use that to formulate the question.
  4) (refer to C@S data set)
  5) Questionnaire of a random sample of secondary school students.
  6) We noticed reaction time test, it would be interesting to see what can affect someone’s reaction time.
  7) You will notice the use of Xbox question, showing whether or not the students use Xbox.
  8) Research question: “Do students that play Xbox have a better reaction time than those that don’t?”

- **Plan Step**
  1) We are using an existing data set and the surveying, sample size, and collection method have already been determined. However, it is still necessary to indicate and understand the method in which the data has been collected.
  2) Design of study: Online questionnaire of secondary school students throughout Australia.
  3) Sample size: random sample of 200 out of about 100,000 students who took the questionnaire.
  4) Reaction time test is done on their computers.

- **Data Step**
  1) Management and organisation of data.
  2) Take only Xbox and reaction time columns, erase data with empty entries, use only the best of two times.

- **Analysis Step**
  1) Found mean, median, min and max

- **Conclusion Step**
  1) Interpret the data to answer my research question.
  2) Which group has faster reaction times based on the mean and median?
Further Thought About the Example

- Further Thought
  1) Could the speed of their computer have had an affect on the result?
  2) Would playing video games in general have a correlation with reaction time?
  3) Would there be a correlation between reaction times based on how much they play Xbox?
  4) Would there be a correlation between reaction times based on how much they play Xbox?
  5) Do you have any other ideas?
Try it for Yourselves

- Split into groups
- Follow the instructions on page 4 to
  - Create your own research question using the Survey Question Set specified by the proctor
  - Go through the PPDAC cycle and explain how you would approach each step of the process
- Write down your research question and approach to the PPDAC cycle on the paper provided

Discovering the Statistical Enquiry Cycle (~30 Minutes)

- PPDAC Cycle Activity: The objective of this is to have each group create their own hypothesis to aid in developing their understanding of the PPDAC cycle. Provide each group with a Question Set, large piece of paper, and markers. Throughout the activity, be available to help the groups.
  1) Split the participants into groups of 3-5 people.
  2) Provide each group with a Survey Question Set, large piece of paper, and a marker(s).
  3) The Instructions are on page 4.
  4) Walk the groups through the objective and instructions to the first part of the activity:
    a) The idea is for each group to create their own research question.
    b) Explain that the survey question sets are for fun just to show the process
    c) Explain the process of creating a question and note that the response type column does not matter for this part of the activity.
    d) Provide 5 minutes for groups to work through the first part. Let the groups know that they will have to present their research question.
  5) Once time is up, have each group (without coming up to the front) talk about what their research question is.
    a) For any group that is having trouble, aid in developing and focusing their research question.
  6) Walk the groups through the objective and instructions to the second part of the activity:
    a) Groups need to take their research question and apply it to the best of their ability to the data cycle.
    b) Note that the plan step is taken care of because they are using an existing data set.
    c) Hint that the response type column plays a big part in how you will work with and represent the data.
  7) As the allowable time begins to come to a close, notify the groups to finish up. At the end, each group with come up with their research question and describe how they went through each step of the process and why they chose that direction. Ask other groups how they could have improved their process.
Resources: Introduction (~1 Minute)

- **Introduce the list of resources**: The objective of this introduction is to list the resources that the ABS provides and to identify that they are all free.
  1) Introduce resources that the ABS provides
  2) These resources include CensusAtSchool, Statpak, and Microsoft Excel help. The best part of all is that each resource is free.
  3) Look at the handout for an explanation on how to get to the CensusAtSchool, Statpak, and the ABS Microsoft Excel help web pages.
CensusAtSchool

- CensusAtSchool is an education project that provides students and teachers with real relevant data
- Countries all around the world are involved in the project
- Using CensusAtSchool Data (CD)
  - Click here

**Resources: CensusAtSchool (~5 Minutes)**

- Explain what CensusAtSchool is:
  1) CensusAtSchool is an education project.
  2) Students answer questions of interest about themselves by completing the CensusAtSchool online questionnaire.
  3) The questionnaire response data is then released back to teachers and students provide real data, for use with the supporting activities across the curriculum in all states and territories from Australia.
  4) The questionnaire and the data used in the PPDAC activity actually from CensusAtSchool.
  5) This education project is in the midst of allowing students from all around the world to look at the data from different countries like Canada, England, South Africa, New Zealand as well as Australia.

- Explain how they can find out more information:
  1) Refer to the page 10 to find CensusAtSchool online.

- Show how to get the data from CensusAtSchool:
  1) Getting data from the CensusAtSchool database is easy. Here is a 3 minute clip on how to obtain the data.
  2) Note to facilitator: Make sure the Using CensusAtSchool Data CD is in the computer, and then click on the “Click here” link on the slide. The file from the CD should play.
  3) Tell the participants that they will receive the CD. Refer to page 9 to see a visual representation of how to access ABS education resources.
Resources: Statpak (~1 Minute)

- Introduce to the students what Statpak is:
  1) An online catalogue
  2) It show-cases ABS publications selected for their relevance to the curricula
  3) The publications are broken down into the different subjects
- Explain the details of Statpak:
  1) Subjects it focuses on: Economics, Environmental studies, Geography, History, SOSE, Mathematics, Tourism, Indigenous Studies, Industry and Enterprise, Information Technology, PE and Agriculture, Arts, Careers, Commerce, Crime,
- Explain how to find Statpak on the ABS website:
  1) www.abs.gov.au/, then go to Education Resources → Statpak Online. Refer to the handout to see this.
• Trouble with Excel? ABS provides resources that help make sense of the program and its features

**Resources: Microsoft Excel (~1 Minute)**

- **How to use Excel:**
  1) ABS does provide information on how to use excel
  2) It covers general usage and features you might encounter when working with the CensusAtSchool data.
  3) Refer to your handout about how to get excel help.
Resources: Promotional Materials (~1 Minute)

- **Handouts:**
  1) Includes a CensusAtSchool Pen, ruler, and calculator,
  2) brochures on NESU as well as CensusAtSchool.
  3) The CD and DVD will help you get started with CensusAtSchool.
  4) The Tale of Two Worlds is a game you can give to your kids.
How you can Help

- Please fill out the evaluation in the back of your packet.
- Your input provides a valuable resource for us to make this workshop even better.

Thanks!

Evaluation of the Workshop (~5 Minutes)

- Evaluation instructions:
  1) Have each participant spend a couple of minutes filling out the evaluation in the back of the packet.
Conclusion of the Workshop (~1 Minute)

Instructions:
1) ABS can help with any questions you might have about statistics, teaching, or anything covered in this workshop.
2) Send an e-mail to schools@abs.gov.au
3) Visit the website at www.abs.gov.au.
4) All of the contact information is located on page 11 of their packet.
5) Thank the audience for having the workshop come to their school.

For Further Questions…

• The National Education Services Unit of the Australian Bureau of Statistics can be reached at:
  – Phone 1800 623 273
  – Fax 03 9615 7798
  – E-mail schools@abs.gov.au
  – Mail GPO Box 2796, Melbourne, Victoria 3001
  – Web www.abs.gov.au
Dealing with Data

Facilitated by:
Conn Dickson
Ben Dwyer
Andrew Lingenfelter
Data in the News

Activity 1: Longer Hours and Less Leisure

From the article 'Longer Hours and Less Leisure: We’re a Nation of Workaholics' of The Australian, March 7, 1995 pg. 1

Please write down any comments about the graphs:

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Activity 2: Beware the Pushy Fish-Eater

Men who eat a lot of fish are driven by ambition and the desire for success, British researchers claim.

Seven in 10 men who frequently eat canned tuna, sardines, salmon, mackerel or kippers admit to being ambitious, and one in two rate themselves as more successful than others.

The study, commissioned by John West Foods, reveals they are also thin-skinned types, with only 5 per cent of regular fish-eaters saying they coped well with criticism compared with a quarter of the non-fish eaters.


Please write down any comments about the article:

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
Are You a Data Detective?

Problem
- understanding and defining the problem
- how do we go about answering this question

Plan
- what to measure & how?
- study design?
- recording?
- collecting?

Data
- collection
- management
- cleaning

Analysis
- sort data
- construct table, graphs
- look for patterns
- hypothesis generation

Conclusion
- interpretation
- conclusions
- new ideas
- communication

Data detectives use PPDAC
PPDAC Group Activity – Instructions

Please feel free to ask your proctor(s) any questions as you go through the activity.

1. As a group, create your own research question using the Survey Question Set provided by the proctor. When developing your research question, use the following instructions as a guide:
   a. Choose one of the topics for the focus of the problem.
      i. Example: Choose ‘The importance of reducing greenhouse gases.’
   b. Choose another topic to compare with the focus topic.
      i. Example: Choose ‘Stance on if we should clean up our rivers and streams.’
   c. Combine the focus topic and the comparison topic to form the hypothesis.
      i. Example: People who are concerned about reducing greenhouse gases are also concerned about cleaning up the rivers and streams.

2. Once your group has completed creating a research question, go through the rest of the PPDAC cycle and think about how you would approach each step. Try to address as many questions as possible by the end of the activity:
   a. Plan step
      i. Assume that the same reliable data set from the Xbox demonstration is used.
   b. Data step
      i. How would you manage and organize the data?
   c. Analysis step
      i. What tools might you use to analyze the data?
      ii. How would you process the data and why?
      iii. How would you present the data and why?
   d. Conclusion step
      i. How would you use the results from an analysis to answer your research question?
### PPDAC Group Activity – Survey Question Set A

<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
<th>Response Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Favorite music includes classical</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Favorite music includes country music</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Favorite music includes heavy metal</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Favorite music includes jazz</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Favorite music includes punk rock</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Favorite music includes rap/ hip hop</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Favorite music includes reggae</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Favorite music includes rhythm and blues</td>
<td>Yes/ No</td>
</tr>
<tr>
<td>9</td>
<td>Favorite music includes rock and roll</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Favorite music includes techno</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Importance of saving old growth forests</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Importance of conserving the marine Environment</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Importance of reducing packaging</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Importance of recycling rubbish</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Importance of reducing water pollution</td>
<td>Strongly Agree/ Agree/ Disagree/ Strongly Disagree</td>
</tr>
<tr>
<td>16</td>
<td>Importance of reducing green house gases</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Importance of climate change</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Importance of the use of ocean resources</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Stance on if water will always be of high quality</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Stance on if recycled water should be used to water gardens</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Stance on if we should clean up our rivers and streams</td>
<td></td>
</tr>
<tr>
<td>Topic</td>
<td>Description</td>
<td>Response Type</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Internet time is spent surfing the web</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Internet time is spent buying and selling goods</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Internet time is spent in a chatroom</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Internet time is spent E-mailing</td>
<td>Yes/ No</td>
</tr>
<tr>
<td>5</td>
<td>Internet time is spent on school work</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Internet time is spent downloading music files</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Internet time is spent playing games</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Importance of reducing packaging</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Importance of recycling rubbish</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Importance of the use of ocean resources</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Importance of the impacts of tourism</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Stance on if there will always have plenty of water</td>
<td>Strongly Agree/ Agree/ Disagree/ Strongly Disagree</td>
</tr>
<tr>
<td>13</td>
<td>Stance on if recycled water should be used to water gardens</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Stance on if my household should use less water</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Stance on if water restrictions should be permanent</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Stance on if all new houses and buildings should have water saving devices</td>
<td></td>
</tr>
<tr>
<td>Topic</td>
<td>Description</td>
<td>Response Type</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>A mobile phone can be used at home</td>
<td>Yes/ No</td>
</tr>
<tr>
<td>2</td>
<td>A computer game can be used at home</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>The Internet can be used at home</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>A game boy can be used at home</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>An MP3 player can be used at home</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>A radio can be used at home</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>A television can be used at home</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>An X-box can be used at home</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Importance of saving old growth forests</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Importance of conserving the marine environment</td>
<td>Strongly Agree/ Agree/ Disagree/ Strongly Disagree</td>
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<td>Importance of climate change</td>
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<td></td>
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<td>Importance of the impacts of tourism</td>
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</tr>
<tr>
<td>17</td>
<td>Stance on if water will always be of high quality</td>
<td></td>
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<tr>
<td>18</td>
<td>Stance on if recycled water should be used to water gardens</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Stance on if we should clean up our rivers and streams</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Stance on if water restrictions should be permanent</td>
<td></td>
</tr>
</tbody>
</table>
### PPDAC Group Activity – Survey Question Set D

<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
<th>Response Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Usually involves a motor cycle</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Usually involves a bicycle</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Usually involves a bus</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Usually involves a tram or train</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Usually involves a car</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Usually involves walking</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Usually involves other methods</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Importance of reducing packaging</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Importance of recycling rubbish</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Importance of reducing water pollution</td>
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<td>Importance of the impacts of tourism</td>
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<td>18</td>
<td>Stance on if water restrictions should be permanent</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Stance on if all new houses and buildings should have water saving devices</td>
<td></td>
</tr>
<tr>
<td>Topic</td>
<td>Description</td>
<td>Response Type</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Time spent hanging out with friends</td>
<td>Hours per week</td>
</tr>
<tr>
<td>2</td>
<td>Time spent talking on the phone</td>
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<tr>
<td>3</td>
<td>Time spent doing homework</td>
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<tr>
<td>4</td>
<td>Time spent with their family</td>
<td></td>
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<tr>
<td>5</td>
<td>Time spent sports/ outdoor games</td>
<td></td>
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<tr>
<td>6</td>
<td>Time spent playing video games</td>
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<tr>
<td>7</td>
<td>Time spent using a computer/ Internet</td>
<td></td>
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<tr>
<td>8</td>
<td>Time spent sending SMS or instant messages</td>
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</tr>
<tr>
<td>9</td>
<td>Time spent in paid job</td>
<td></td>
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<tr>
<td>10</td>
<td>Time spent doing housework</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Importance of saving old growth forests</td>
<td>Strongly Agree/ Agree/ Disagree/ Strongly Disagree</td>
</tr>
<tr>
<td>12</td>
<td>Importance of reducing packaging</td>
<td></td>
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<tr>
<td>13</td>
<td>Importance of recycling rubbish</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Importance of reducing water pollution</td>
<td></td>
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<td>15</td>
<td>Importance of reducing green house gases</td>
<td></td>
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<tr>
<td>16</td>
<td>Importance of climate change</td>
<td></td>
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<tr>
<td>17</td>
<td>Importance of the use of ocean resources</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Stance on if there will always have plenty of water</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Stance on if recycled water should be used to water gardens</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Stance on if we should clean up our rivers and streams</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Stance on if my household should use less water</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Stance on if water restrictions should be permanent</td>
<td></td>
</tr>
</tbody>
</table>
Accessing ABS Education Resources

ABS Homepage
http://abs.gov.au

Education Resources
→ Click on “Education Resources” along the top bar

CensusAtSchool (C@S)
→ Click on “CensusAtSchool”, and then “Teacher Area”
  • CensusAtSchool data is acquired from online questionnaires done by Australian students
  • The data is real and directly applies to students
  • A random sample of the large pool of data can be taken from the database and analyzed
  • C@S data from other countries around the world can also be used for comparison

Excel Help and Other C@S Help
→ Click on “using CensusAtSchool” under the heading “Assistance with CensusAtSchool”, and then “Microsoft Excel Skills Training” or the other options for further help

Teacher Tools and Classroom Activities
→ Click on “Teacher tools and classroom activities”
  • Has lesson plans for many KLAs
  • Has students activities
  • Has other statistical resources

Statpak Online
→ Click on “Statpak Online”, and then the subject you want
  • Has ABS data publications organized by KLA
  • Meant to help teachers find data pertaining to their KLA so that it may be used in the
Contact Information

The Australian Bureau of Statistics is available to help out with any questions you might have regarding all topics covered in this workshop as well as further help with understanding statistics and how to bring it into the classroom.

The National Education Services Unit of the Australian Bureau of Statistics can be contacted by:

Phone: 1800 623 273
Fax: (03) 9615 7798
E-mail: schools@abs.gov.au
Mail: GPO Box 2796, Melbourne, Victoria, 3001
Web: www.abs.gov.au

CensusAtSchool questions can be sent to:

Phone: 1800 623 273
Fax: (03) 9615 7798
E-mail: censusatschool@abs.gov.au
Mail: GPO Box 2796, Melbourne, Victoria, 3001
Workshop Evaluation

Please answer the following questions:

1. What university are you currently attending?

2. What subject and year(s) do you plan on teaching?

Please circle the number that corresponds to how much you agree with the statement.

0 = Strongly Disagree  1 = Disagree  2 = Agree  3 = Strongly Agree

<table>
<thead>
<tr>
<th>Statement</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brainstorming how data fits into society showed the importance of data in society.</td>
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<tr>
<td>The news articles demonstrated the importance of understanding data.</td>
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<tr>
<td>Identifying how data fits into VELS illustrated how data relates to my subject.</td>
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<tr>
<td>The PPDAC cycle illustrated how to develop data to solve a research problem.</td>
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<tr>
<td>The terms used to describe the PPDAC cycle were easy to understand.</td>
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<tr>
<td>Demonstrating each step in the cycle was helpful for understanding the process.</td>
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<tr>
<td>The group activity helped me understand how to use the PPDAC cycle</td>
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<tr>
<td>The question sets for the group activity stimulated my interest.</td>
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<tr>
<td>There was enough time for my group to finish the group activity.</td>
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<tr>
<td>CensusAtSchool is a program that I am interested to learn more about.</td>
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<tr>
<td>Statpak Online is a program that I am interested to learn more about.</td>
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<tr>
<td>I enjoyed the overall presentation style of the workshop.</td>
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<tr>
<td>I found the structure of the workshop to be well organized.</td>
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<tr>
<td>The workshop was effective in showing me how to use statistics in the classroom.</td>
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<tr>
<td>The workshop has helped encourage me to include statistics in my classroom</td>
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<td></td>
</tr>
</tbody>
</table>

What did you like most about the workshop and why?

What did you like least about the workshop and why?

Please comment on how ABS can improve the effectiveness of the workshop:

To measure the impact of the workshop in the classroom, we would like to send you a short questionnaire after nine (9) months and two (2) years time from now. If you would be willing to participate, please provide your name and e-mail address.

Name:  E-Mail:
Appendix G: VELS Level 5 Mathematics Standards

Level 5

Learning focus

As students work towards the achievement of Level 5 standards in Mathematics, they construct mathematical models to explore and describe the physical world. They recognise the importance of mathematics in a technological society.

In Number, students investigate and explore whole numbers and fractions as squares, square roots and other simple powers. They express natural numbers as products of prime number factors.

Students use number lines and materials to compare quantities using ratios, and to form equal ratios using proportion. They use ratios of number pairs to understand constant rate of change. They use number lines, graphs, numerical or algebraic means to solve proportion problems and percentage problems as proportion relative to 100.

Students use patterns with division to develop understanding of infinite decimals, and recognise the existence and applications of non-repeating infinite decimals (for example, π). Students use mental, written or calculator methods for computations, including multiple operations using rounding and estimation to provide suitable answers for practical situations. They use materials and patterns to understand binary numbers and to add and subtract using this notation.

In Space, students construct shapes and regular polygons to given specifications. They explore the properties of angles formed by intersecting straight lines. They use ideas of congruency and similarity to create and describe designs and applications. They use nets for common three-dimensional shapes to construct corresponding geometric objects. They use perspective to draw three-dimensional objects on paper.

Students interpret and use a range of familiar and common maps of locations from small to large scale, using plans and grids. They explore the patterns formed by following procedures involving simple transformations or movements around grids. They use networks to represent relationships in everyday life (for example, a tree diagram for a family tree and a network to show the route used to travel to school).

In Measurement, chance and data, students use metric units to estimate and measure length, perimeter, area, surface area, mass, volume, capacity, angle in shapes and solids, time, and temperature. They convert metric units into smaller or larger units as required. They judge the accuracy of their estimates by measurement and calculate error. They use mensuration formulas (for example, for area and perimeter of circles, area and perimeter of triangles and...
Appendix H: VELS Level 5 Geography Standards

Level 5

Learning focus

As students work towards the achievement of Level 5 standards in Geography, they use a variety of geographic tools and skills, together with an inquiry-based approach, to investigate the characteristics of the regions of Australia and those surrounding it: Asia, the Pacific and Antarctica. They explore how and why, over time, human and physical interactions produce changes to the characteristics of regions, for example, settlement patterns and agricultural and urban land use.

Students extend their knowledge and understanding of physical phenomena, including natural hazards, and of the physical processes that produce them. They identify patterns of distribution and occurrence of major physical features and their interrelationship with human activities such as farming, fishing, manufacturing and settlement. Students become aware of contrasts within the regions of Australia and those surrounding it from their investigation of a number of smaller regions such as South-East Asia, the South Pacific nations and Papua New Guinea. They develop an appreciation of differences in the culture, living conditions and outlooks of people, including the Aboriginal and Torres Strait Islander peoples, in those areas.

Students investigate environmental issues such as forest use and global warming. They begin to design policies, and evaluate existing policies, for managing the impact of these issues and ensuring the sustainability of resources.

Students apply their knowledge and understanding of scale, grid references, legend and direction to use large-scale maps (such as topographic maps), as sources of spatial information, as well as other spatial representations (such as those found in atlases and geographic information systems). Students research and analyse photographs, maps, satellite images and text from electronic media and add these to their presentations.

Observing basic mapping conventions, students learn to draw overlay theme maps. They recognise that parts of the Earth’s surface can be represented in various ways, at different scales, and from different perspectives on a range of maps, photographs and satellite images. They are provided with opportunities to collect and process data and present a summary of results using a range of techniques such as sketch maps, graphs and electronic media (such as geographic information systems and spreadsheets).

Students undertake fieldwork to investigate the characteristics of a selected local region and the physical processes and human activities that form and transform it. Students are encouraged to participate in activities to contribute to the sustainable management of local places.
Appendix I: VELS Level 5 Economics Standards

Level 5

Learning focus

As students work towards the achievement of Level 5 standards in Economics, they develop an understanding of the nature of scarcity, opportunity cost and resource allocation, and how these influence the Australian economy.

They consider the use, ownership and management of resources in personal, business and community contexts, and participate in activities in which they begin to appreciate that economic choices involve trade-offs that have both immediate and future consequences. They learn that a market, consisting of buyers and sellers, is one method of allocating resources. Students begin to identify markets in which they participate, and how the interaction of buyers and sellers influences prices. They explore how access to resources is a significant factor in determining income levels and appreciate that people’s incomes, in part, reflect choices they have made about education, work, careers and skill development.

Students develop personal financial literacy skills and an understanding of the importance of being an informed consumer. They practice making informed consumer decisions. They consider the nature of current and future work opportunities and factors that influence such opportunities. They learn about the nature of business and business ownership, and begin to gain an understanding of concepts such as risk-taking, competition, and supply and demand.

Students learn about the role of government in influencing economic activity and managing the economy.

Students use the inquiry process to plan economic investigations, analyse and interpret data, and form conclusions supported by evidence. For example, students investigate the way resources are allocated in various markets such as the housing market, the Australian Football League players’ market, the local community market and the chocolate market. They begin to form and express opinions on economic issues that interest and/or impact on them personally, or locally and nationally.

Definitions of undefined terms are provided in the Glossary (page 23)
Appendix J: VELS Level 5 History Standards

Level 5

Learning focus

As students work towards the achievement of Level 5 standards in History, they develop knowledge and understanding about ancient and medieval societies and their role in providing the foundations of modern society. They consider why people at the end of the medieval period set out to discover the unknown world. They investigate some voyages of this period and New World discoveries during the Age of Exploration. Ancient societies could include civilisations of China, Rome, Greece and Egypt. Medieval societies could include those from England, Europe, Asia or an Islamic society. The Age of Exploration could include the discoveries of the Portuguese explorers, Christopher Columbus, Ferdinand Magellan, Francis Drake, the French explorers, Henry Hudson and James Cook. The learning enhances students' knowledge and use of historical concepts such as time – chronology and sequencing, change and continuity – and cause and effect, and develops a broad historical map which allows them to locate periods of history within a timeframe.

Students explore key concepts of democracy, governance, the role of law, justice, religion, liberty, authority, leadership, culture and feudalism. Students begin to use a variety of sources that record the features of these past societies. They investigate daily life, the role and work of various groups, the division of labour between men and women, education, rituals and family. They explore the values and beliefs of societies through their religions, myths and legends, and their social and political structures. Students examine the ways the culture was expressed through art, music, literature, drama, festivals and education. They learn about key events, significant individuals, and the influence of trade and contact with other cultures.

Students explore the legacies of ancient and medieval societies for contemporary societies. For example, they consider the origins of written law, democracy and the calendar; the limitations on the power of the monarchs (through the Magna Carta), the role of law and the writ of habeas corpus; and the origins of major world religions.

Through their investigations, students develop their understanding of change and continuity over time, and the opened-ended nature of historical inquiry. Students examine the influence of ancient and medieval societies on the present day, and make comparisons with contemporary societies.

Students begin to frame key research questions to guide their investigations, plan their inquiries, locate sources and use appropriate historical evidence to present a point of view, and report on their findings. They learn to use primary and secondary sources, and begin to evaluate historical sources for meaning, completeness, point of view, values and attitudes. They reflect on some of the
Appendix K: VELS Level 5 Science Standards

Level 5

Learning focus

As students work towards the achievement of Level 5 standards in Science, they develop their understanding of The Law of Conservation of Energy and The Law of Conservation of Mass and apply these laws to familiar and new situations. They expand their knowledge of science to include abstract concepts, theories, principles and models drawn from traditional and emerging sciences. They apply these to particular situations. Examples include: changing the rate of chemical reactions; using gear systems to demonstrate the relationship between force and energy; investigating the formation of rocks and minerals, including fossil fuels; modeling earthquakes as examples of geological processes; explaining tidal patterns; expanding their ideas of space science to include nebulas, comets, stars, galaxies and the Universe; and relating sustainability to the requirements for species survival and the management of resources.

They develop an understanding of themselves as organisms composed of different cells and systems working together. They explore the relationship between system failure and disease, in humans. They investigate disease at the cellular, tissue and human body levels.

Students explore how scientific work has led to the discovery of new knowledge and understanding about the natural world and changed our understanding of ourselves and our future. Examples include the use of fossils and other information to construct a time scale for the history of Earth; the development of a classification system for living things, past and present; and the use of the particle model of matter to explain the behaviour of materials. They learn that the nature of scientific thinking is not static and relies upon knowledge, understanding and skills that are built up over time, shared and reflected upon, while incorporating new ideas, thinking and experimental evidence.

Students develop their understanding through the use of science ideas (theories, laws, principles and models) applied in particular situations; for example, testing formal understandings in controlled studies using appropriate experimental tools. They discuss and elaborate particular theoretical knowledge or ways of working in areas of personal or public concern, interest or career, including researching scientific ideas expressed in science magazines and science fiction texts.

Students develop skills in measuring mass, volume and density. They learn to use appropriate units of measurement. They participate in activities in which they identify, prepare and separate mixtures and solutions. They learn to use basic sampling procedures when conducting fieldwork. They design

Definitions of undefined terms are provided in the Glossary (page 23)
## Appendix L: Skills Related to Statistics in VCE Study Designs

### Skills Related to Statistics in VCE Mathematics

<table>
<thead>
<tr>
<th>Foundation Mathematics: Units 1 and 2</th>
</tr>
</thead>
</table>
| 1. Understand common features, conventions and basic terminology used when interpreting and preparing information in graphical or tabular form.  
2. Interpretation and use of graphs, graphics and tables.  
3. Understand common methods of presenting data, including simple frequency tables and simple graphs such as bar and line graphs and pie graphs.  
4. Use and interpretation of the average and range of a set of data in practical situations and in the media.  
5. Apply technology to the display of data in various forms such as bar graphs, line graphs, and pie graphs. |

<table>
<thead>
<tr>
<th>General Mathematics: Units 1 and 2</th>
</tr>
</thead>
</table>
| 1. Apply ratio, proportion and percentage concepts.  
2. Use categorical data and numerical data.  
3. Understand displays and their interpretation such as: frequency tables and bar charts for categorical data, dot plots, stemplots, frequency tables and histograms for numerical data.  
4. Summarize numerical data using measures of central tendency and spread such as: mean, median and mode, range, interquartile range, variance and standard deviation.  
5. Use five-number summaries for a set of data and graphically represent it by means of a boxplot.  
6. Understand and interpret the patterns and features of scatterplots.  
7. Use correlation and regression to fit a line to data.  
8. Use the stages of simulating a mathematical model: formulation, solution, interpretation, validation and improvement of model. |

### VCE Mathematics (VCAA Mathematics, 19)

### Skills Related to Statistics in VCE Biology

|  
|----------------------------------------|  
| 1. Formulate questions and construct hypothesis appropriate for conducting investigations.  
2. Plan, design, and conduct investigations.  
3. Evaluate experimental procedures and reliability of data.  
4. Collect, process and record information systematically.  
5. Analyze and synthesize data  
6. Draw conclusions consistent with the question under investigation and the evidence obtained.  
7. Analyze and evaluate the reliability of information and opinions presented in the public domain. |

### VCE Biology (VCAA Biology, 12)
### Skills Related to Statistics in VCE Chemistry

1. Conduct investigations that include collecting, processing, recording and analyzing qualitative and quantitative data.
2. Draw conclusions consistent with the question under investigation and the information collected.
3. Evaluate procedures and reliability of data.
4. Construct questions and hypotheses.
5. Plan, design and conduct investigations.
6. Identify and address possible sources of uncertainty.
7. Apply ethics of scientific research when conducting and reporting on investigations.
8. Analyze and evaluate the reliability of chemistry related information and opinions presented in the public domain.

VCE Chemistry (VCAA Chemistry, 12)

### Skills Related to Statistics in VCE Physics

1. Identify and assess the validity and reliability of underlying assumptions and/or limitations of models, data and conclusions.
2. Develop skills in the design and conduct of practical investigations including data collection, analysis and critical evaluation of conclusions.
3. Identify alternate interpretation of results.
4. Effectively communicate the results of research and investigations.
5. Understanding the use of experimental data acquisition and analysis.

VCE Physics (VCAA Physics, 13)

### Skills Related to Statistics in Economics

1. Develop an understanding of the relationship between economic events and outcomes.
2. Use economic concepts, models and methods of inquiry to make informed life choices.
3. Express, interpret and analyze economic information.
4. Construct graphs and tables to represent economic data.
5. Analyze statistical and graphical data
6. Calculate percentage changes in economic variables.
7. Gather relevant data and information about the Australian Government’s economic objectives.
8. Describe trends, patterns, similarities and differences in economic data.
9. Recognize the limitations of economic data.

VCE Economics (VCAA Economics, 22)
**Skills Related to Statistics in VCE Geography**

1. Understand and apply spatial concepts of location, scale, distance, distribution, region, movement, spatial change over time, spatial association and spatial interaction.
2. Acquire knowledge of the interaction and interdependence of natural processes and human activities, including attitudes and values that influence decision making in relation to geographical issues and questions.
3. Develop and apply skills of observation, data collection, analysis, explanation, synthesis and evaluation from both primary and secondary sources,
4. Communicate information effectively and as appropriate to the task and audience, in a variety of ways, including orally and/or in writing, accompanied by maps, diagrams, photographs, graphs and tables.

**VCE Geography (VCAA Geography, 13)**

**Skills Related to Statistics in VCE History**

1. Develop the knowledge, concepts and skills to analyze the ways in which the past has been represented visually, orally and in written form.
2. Develop skills in responding to historical evidence creatively and critically to make meaning of the past.
3. Synthesize evidence to draw conclusions.

**VCE History (VCAA History, 13)**
Appendix M: Statistical Outreach Programs

Statistical Organizations all around the world have developed effective outreach programs to increase statistical literacy. Secondary colleges have taken advantage of programs and resources to teach their pupils statistics. The statistical programs are organized by their respective target audience.

Programs Targeted to Teachers

There are a few statistical resources that are targeted to teachers. These programs are StatPak Online and the Statistics Teachers Network (STN). Statpak Online is a program that has ABS publications organized in a certain way for teachers. The STN is a newsletter for maths teachers.

Statpak Online

Statpak Online provides online resources targeting librarians and schoolteachers with selected publications by ABS. As of December 2005, this program became a free service. ABS categorizes their publications into sixteen different learning areas. They provide the material as either electronic documents in PDF or HTML formats, or as a spreadsheet. All the copies can be printed and delivered for a fee, or the individual can access the statistical material and print it themselves (ABS, pars. 1)

This program was originally created in 1991 so that teachers could have a resource that organized the ABS publications by the Key Learning Areas. The ABS hired a practicing teacher to examine each of the ABS’s publications and determined the relevance of each publication according to the KLAs. ABS then published Statpak and promoted it to the schools that used the unorganized publications before Statpak was created. The booklet became too expensive to publish, so Statpak went online.
Statpak Online presents the same publications as the original Statpak, but it is available to teachers as an online resource.

**Statistics Teachers Network**

The Statistics Teacher Network (STN), established in 1967 by the National Council of Teachers of Mathematics Joint Committee on Curriculum in Statistics and Probability for Grades K-12, is a newsletter that promotes the use of statistics in primary and secondary schools. STN also provides lesson plans to encourage statistics to be included into a national curriculum (Statistics Teacher Network par. 4).

For example, the latest journal issued by the Committee has an article called, “Showing Pennies” which demonstrates whether a particular penny game is fair. Students get involved by playing the game and seeing if it is fair. After some time, they will find that the game is not fair. Then, using the statistical concepts learned in class, they can prove that it is, in fact, not fair.

Another example of the kind of interesting type of statistics is an analysis of MEGA MILLIONS which was started by the California Lottery. The students analyze the probability of winning the MEGA MILLIONS, and then compare the probability of winning with what is indicated on the ticket.

**Programs Targeted to University Students**

Another target audience are University students. There are not many programs currently in existence that target the students. The Australian Young Statistician is a program that targets university students majoring in statistics.
Australasian Young Statistician

The Statistical Society of Australia is a society that supports statisticians of Australia, as well as individuals overseas. There are approximately 950 members. They have their own newsletter and organize national conferences.

One of their programs is called the Australian Young Statistician (AYS). This program is for individuals who wish to get into the field of statistics, or are currently majoring in the area. They also do various workshops separate from the AYS which unite people in undergraduate and graduate studies to comment to the other statistical community.

This outreach program was implemented from recognizing the need for a statistical program and competition for university students. This seems to be a valuable resource since the AYS have 1) made a workshop and 2) had a workshop that targets students. Though they were not targeting trainee teachers, there could still be lessons to be learned. In the description of the workshop, it shows that there was a competition for the best presentation. The winner received a $200 US cash prize.

(AYS)

Programs Targeted to Primary and Secondary College Students

There are many programs targeted to primary and secondary college students. Below is a summary of four programs that target this audience. These programs are: CensusAtSchool, RSSCSE’s lesson plans, ASA’s curriculum collaboration, and finally ASA’s Adopt-A-School program.
CensusAtSchool

Another program is called CensusAtSchool. It is

“a FREE Internet based data collection and analysis project. Students from years 5 to 12 collect real data about themselves by completing the CensusAtSchool online questionnaire. Teachers and students are then able to access the questionnaire response data and use it as a classroom resource to explore and investigate any number of topics.” (Australian CensusAtSchool, pars. 2)

CensusAtSchool fulfills the cross-curriculum needs that experts believe is required to make learning statistics both fun and educational (Giesbrecht 7). The CensusAtSchool program analyzes data pertaining to major student issues that students from five different countries gather through classroom censuses. This helps students relate to the data better, which makes it more exciting to analyze.

The Australian CensusAtSchool is based upon a program developed by the Royal Statistical Society. The program was developed to have different stages of the census. They are collection of the data from the students, processing and presentation of the data (done by ABS), then use of the data by the students and teachers. These stages are required to implement and integrate the CensusAtSchool program into the classroom.

RSS also studies and reviews education in mathematics. RSS published a report entitled, *Science Teaching in Schools – Report with Evidence*. It analyzed student activities and teaching methods and used the results of their study to provide a
summary of recommendations to the House of Lords. RSS made 22 recommendations; one indicated that teachers are not well qualified to teach statistics and action should be taken to improve teacher’s statistical literacy.

**RSSCSE**

The Royal Statistical Society (RSS) is a British society that encourages the countrywide use of statistics. The RSS states that it is the UK’s only professional statistical society. They also declare that they are dedicated to the promotion of the applied mathematics, whether it is focused on the producers or consumers of statistics (RSS). They also note that they encourage the general population to use more statistics, similarly to ABS.

It is important to note that one of RSS’s charter goals is to make recommendations to the House of Lords, and when RSS does so, the House of Lords accepts the data’s veracity. The connection between RSS and policy makers is of critical importance when improving statistical literacy, as well as science literacy.

The RSS Centre for Statistical Education, or RSSCSE, aims to assure that the public is statistically literate by promoting statistical education. RSSCSE targets three main groups: teachers or lecturers, students, and policy makers. It also works to bring positive statistical awareness to the public through the analysis of controversial events (RSS, Aims and objectives – RSS Centre for Statistical Education).

In an effort to make statistics fun and involve multiple subjects, RSSCSE has links in their news section relating to statistics, which reinforces Giesbrecht’s belief that it is critical to make statistics fun for the audience (7). The news section includes different
links, which could include major events for CensusAtSchool, or new resources that RSSCSE has created. One example how RSSCSE achieves Giesbrecht's vision is by statistically analyzing Dan Brown’s book the *Da Vinci Code*, a novel made into a 2006 blockbuster movie. Students are encouraged to read the book, see the movie, and then do their own statistical analysis on Vitruvian theory. (RSS, RSSCSE News 2).

The *Vitruvian theory – does it apply to you?* lesson plan targets ages 11-18 and looks at arm length vs. height. There are two different lesson plans with different difficulties; one is for 11-14 year olds, and the second level is for 15-18 year olds. Both sets have teacher notes that provide details about how to teach the children. There is even a part that requires the children to use statistical vocabulary in their analysis. (RSS Vitruvian Theory pars 1-4) A statistician created this lesson plan to make statistics more exciting and relatable through relate popular culture.

**ASA Curriculum Collaboration**

The American Statistical Association (ASA) is the second oldest society in the United States. It was started in 1839 and continues today with the same dedication to unbiased statistics. Their mission and vision is to:

- Support excellence in statistical practice, research, journals, and meetings
- Work for the improvement of statistical education at all levels
- Promote the proper application of statistics
- Seek opportunities to advance the statistics profession

(ASA, ASA Vision, Mission, and History pars. 2, 3)
ASA has many educational resources available to improve statistical literacy. One of their programs created a curriculum for grades K-6. The curriculum was tested over several years with different age groups from different locations. This collaboration created a program that incorporates the content knowledge that statisticians can provide with the teachers’ perspective on what methods and lessons would work in a classroom. This innovative marriage of statisticians and teachers is a great idea to be incorporated into the trainee teacher workshop. The program was implemented through the understanding that there must be collaboration between the teachers and the statisticians to understand how to make exciting statistical content.

**Adopt a School**

ASA also has an innovative program called Adopt-A-School. This program connects local statisticians to a school where they teach the students fun concepts about statistics. The statisticians work with the teachers and administrators to come up with appropriate ways of teaching the students. Started in 1993, there were 23 volunteers. Since statisticians are not professional educators, they receive material from ASA to help them understand how to teach and how to relate to the children. ASA also asks the statisticians to discuss poster and project competitions that ASA hosts. This gives the students an opportunity to work together and have fun with statistics. It also keeps the statisticians motivated to continue to interact with the host school. (Adopt a School for Statistics Education pars. 2 5).