

Electronic Delivery of CSIRO Education Programs



CSIRO

An Interactive Qualifying Project Report
submitted to CSIRO Education and the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for the
Degree of Bachelor of Science

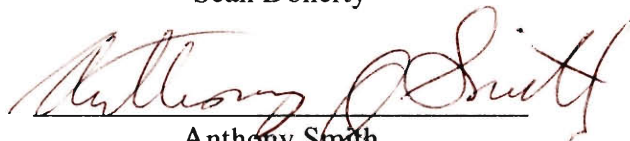
by



Richard Adams



Sean Doherty



Anthony Smith

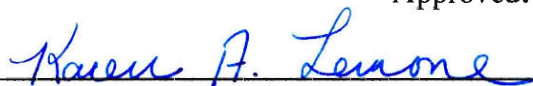
04 May 2004



Search Keywords

1. Education
2. Electronic
3. Media
4. Website
5. CD-ROM

Approved:



Professor Karen A. Lemone, Major Advisor



Professor R. Creighton Peet, Co-Advisor

Abstract

This project, sponsored by the Commonwealth Scientific and Industrial Research Organisation's Science Education Centre of Victoria (CSIRO Education), investigated the use of electronic media to add value to the Centre's extension education programs. After conducting several surveys and focus groups, the project team found that websites containing follow-up information and interactive multimedia would best suit both Victorian teachers and CSIRO Education. The project also created a template for future electronic supplements and a sample website for a CSIRO Education program.

Acknowledgements

The successful completion of our project would not have been possible without the help and mentoring of several people. We would like to especially thank our on-site liaisons, Chris Krishna-Pillay and Rebecca Carter, for giving our project excellent guidance and helping us in countless ways during our stay. We would like to show our appreciation for them and the rest of the CSIRO Education staff for making our experience at the CSIRO Science Education Centre both fun and productive. We would also like to thank our advisors, Karen Lemone and Creighton Peet, for pushing us to do our best throughout the project and for showing us how to make our final product the best it could be. Finally, we would like to thank all of the Victorian teachers and students who participated in our research for giving us the necessary information to produce a useful report for CSIRO Education.

Authorship

Section	Primary Author
Abstract	Anthony
Executive Summary	Rick
1. Introduction	Sean
2. Literature Review (Intro)	Sean
2.1 Motivating Students to Learn	Sean
2.2 Electronic Education Programs	Group
2.2.1 Potential Delivery Methods	Anthony and Rick
2.2.2 Principles of Distance Learning	Anthony
2.2.3 Applications of Technology in Educational Systems	Anthony
2.2.4 Existing Delivery Systems in Australia	Rick
2.3 Case Studies of Electronic Education Programs (Intro)	Sean
2.3.1 Chinese Modern Distance Education Project	Sean
2.3.2 Web-based Education in Catalonia (Spain)	Sean
2.3.3 Distributing Complex Drawings Electronically	Anthony
2.3.4 Study of Regents College	Rick
2.3.5 Distance Learning at WPI	Rick
2.3.6 Distance Education in Australia	Rick
2.3.7 Student Attitudes toward Distance Learning	Anthony
2.3.8 Teachers' Attitudes on Distance Learning	Anthony
2.3.9 Case Study Conclusions	Sean and Rick
2.4 Marketing Technology	Anthony
3 Methodology (Intro)	Sean
3.1 Users' Opinions on Electronic Media (Intro)	Sean
3.1.1 Surveying the Teachers of Victoria	Sean
3.1.2 Focus Groups	Anthony
3.1.3 Student Survey	Rick
3.2 Marketing Electronic Media to Teachers (Intro)	Sean
3.2.1 Marketing Section on Teacher Survey	Sean
3.2.2 Focus Groups with Teachers	Anthony
3.2.3 Student Surveys	Sean
3.2.4 Contacting Vendors of Electronic Media	Sean
3.3 Integrating Electronic Media into Programs	Anthony
4 Results (Intro)	Sean
4.1 Determining Which Electronic Media are Available	Anthony
4.2 Determining Teachers' Opinions (Intro)	Rick
4.2.1 Results from Teacher Survey Distribution	Sean
4.2.2 Analyzing the Desires of Teachers	Sean
4.2.3 Analyzing Teacher Media Rankings	Sean
4.2.4 Analyzing Preferred Electronic Delivery Options	Sean
4.2.5 CSIRO Education Participants vs. Non	Sean
4.2.6 Comparing Results of Different School Types	Rick
4.2.7 Comparing Results Based on School Income	Rick
4.2.8 Teacher Comments	Rick
4.2.9 Focus Groups	Anthony
4.2.10 Student Surveys	Rick

4.3 Marketing CSIRO Education Programs (Intro)	Anthony
4.3.1 Information from Teacher Survey	Anthony & Sean
4.3.2 Information from Focus Groups	Anthony
4.3.3 Contacting Vendors of Technology	Sean
4.4 Integration of Electronic Media into Programs (Intro)	Anthony
4.4.1 Templates for Incorporating Electronic Media	Anthony
4.4.2 Sample Electronic Supplement	Sean
5 Conclusions (Intro)	Sean
5.1 Summary of Completed Work	Anthony
5.2 Recommendations	Group
5.3 Future Work	Group

(All documents were co-edited by the entire group)

Table of Contents

	Abstract.....	i
	Acknowledgements	ii
	Authorship	iii
	Table of Contents	v
	Table of Tables	viii
	Table of Figures	viii
	Executive Summary	ix
1	Introduction	1
2	Literature Review.....	4
2.1	Motivating Students to Learn.....	4
2.1.1	Motivating with ARCS	5
2.1.2	Motivating through Mentoring.....	6
2.2	Electronic Education Programs.....	7
2.2.1	Potential Delivery Methods	8
	E-mail Delivery.....	8
	Intelligent Tutoring Systems.....	9
	CD-ROM Delivery.....	10
	World Wide Web Delivery.....	10
2.2.2	Principles of Distance Learning	11
2.2.3	Applications of Technology in Educational Systems.....	13
2.2.4	Existing Delivery Systems in Australia.....	14
2.3	Case Studies of Electronic Education Programs.....	15
2.3.1	Chinese Modern Distance Education Project.....	16
2.3.2	Web-based Education in Catalonia (Spain)	17
2.3.3	Distributing Complex Drawings Electronically.....	18
2.3.4	Study of Regents College.....	18
2.3.5	Distance Learning at WPI.....	20
2.3.6	Distance Education in Australia.....	21
	Applications in the State of Victoria.....	22
	University of South Australia	22
2.3.7	Student Attitudes toward Distance Learning	24
2.3.8	Teachers' Attitudes on Distance Learning.....	25
2.3.9	Case Study Conclusions.....	26
2.4	Marketing Technology	26
3	Methodology.....	28
3.1	Users' Opinions on Electronic Media in CSIRO Education Programs.....	28
3.1.1	Surveying the Teachers of Victoria.....	29
3.1.2	Focus Groups with Teachers.....	32
	Data Processing of Focus Groups.....	35
3.1.3	Student Survey	36
	Participant Questionnaire	36
	Non-Participant Questionnaire	37
3.2	Marketing Electronic Media to Victorian Teachers.....	38
3.2.1	Marketing Section on Teacher Survey	38
3.2.2	Focus Groups with Teachers.....	39
3.2.3	Student Surveys.....	40
3.2.4	Contacting Vendors of Electronic Media	40

3.3	Integrating Electronic Media into Current CSIRO Education Programs	41
4	Results	43
4.1	Determining Which Electronic Media are Available	43
4.2	Determining Teachers' Opinions of Electronic Media	44
4.2.1	Results of Teacher Survey Distribution.....	44
4.2.2	Analyzing the Desires of Teachers.....	45
4.2.3	Analyzing Teacher Media Rankings	48
4.2.4	Analyzing Preferred Electronic Media Delivery Options.....	49
4.2.5	CSIRO Education Participants vs. Non-Participants: Teachers.....	52
	Comparison of Teachers' Needs.....	52
	Comparison of Media Choices	54
	Comparison of Electronic Media Delivery Section	58
	Analyzing Results of Non-Participating Teacher Section.....	59
	Analyzing Results of Participating Teachers Section	62
4.2.6	Comparing Results of Different School Types	63
4.2.7	Comparing Results Based on School Income	63
4.2.8	Teacher Comments	65
4.2.9	Focus Groups.....	66
	Advantages/Disadvantages of Electronic Media	66
	Delivery Methods.....	68
	Potential Applications	70
4.2.10	Student Surveys.....	71
	Participant vs. Non-participant Student Results	72
4.3	Marketing CSIRO Education Programs to Victorian Teachers.....	75
4.3.1	Information from Teacher Survey	75
4.3.2	Information from Focus Groups.....	77
4.3.3	Contacting Vendors of Technology.....	78
	Websites	79
	CD-ROM.....	81
4.4	Integration of Electronic Media into CSIRO Education Programs.....	81
4.4.1	Templates for Incorporating Electronic Media	82
	Teacher Template.....	82
	Student Template	84
4.4.2	Sample Electronic Supplement	86
	Student Website	87
5	Conclusions and Recommendations	89
5.1	Summary of Completed Research.....	89
5.2	Recommendations	92
5.2.1	CD-ROM.....	92
5.2.2	Website	93
5.2.3	Marketing Issues.....	94
5.2.4	Integration of Electronic Media with CSIRO Education Programs	95
5.3	Future Work	96
	References	98
	Appendix A: Phone Protocol for Encouraging Responses.....	101
	Appendix B: Teacher Survey.....	103
	Appendix C: Focus Group Interview Guide.....	107
	Appendix D: Focus Group Transcripts	109
	Appendix E: Focus Group Summaries	119
	Appendix F: Participant Student Questionnaire	126

Appendix G: Non-Participant Student Questionnaire.....	127
Appendix H: Phone Protocol for Obtaining Permission to Survey Students	128
Appendix I: Transcripts of Interviews with Electronic Media Vendors	129
Appendix J: Results of All Questions on Teacher Survey	133
Appendix K: Results of All Questions on Student Survey.....	146
Appendix L: Field Notes from Observation of CSIRO Education Programs	156
Appendix M: Screen Shots of Sample Website.....	162

Table of Tables

Table 4.1: Comparison of Distribution of Sample Population and 45

Table 4.2: Would CSIRO Education programs be more appealing if: 53

Table 4.3: Appeal of potential CSIRO Education program additions to teachers: 59

Table of Figures

Figure 3.1: Composition of Sample Population (Right) and Overall Population (Left) .. 30

Figure 4.1: Results of Question 5: Desire for supplementary lessons to be used after
CSIRO Education demonstrations by teachers..... 46

Figure 4.2: Desire for website to facilitate discussion among students on scientific
topics 47

Figure 4.3: Results of Section 2: Rankings of usefulness of electronic media..... 48

Figure 4.4: Desire for follow-up lessons/information to be electronically delivered to
teachers after CSIRO Education program..... 50

Figure 4.5: Teachers’ preferred electronic media for delivery of supplementary
program materials 51

Figure 4.6: Appeal of Website to facilitate discussion among students on scientific
topics 54

Figure 4.7: Ranking received by CD-ROM’s 55

Figure 4.8: Ranking received by a website containing only information..... 56

Figure 4.9: Ranking received by a website with interactive elements 57

Figure 4.10: Ranking received by videos of presentations for viewing on the Internet... 58

Figure 4.11: Agreement with the statement: “This media would make programs more
appealing” 60

Figure 4.12: Agreement with the statement: “Follow-up materials have made
programs more useful/appealing” 61

Figure 4.13: Question 5: Potential helpfulness of a CD-ROM in supplementing this
program 62

Figure 4.14: Overall ranking of electronic media types (left)..... 63

Figure 4.15: Do you go online often at school? 64

Figure 4.16: Do you go online often at home?..... 64

Figure 4.17: Appeal to students of online discussions 72

Figure 4.18: Top Left side: Participants –Do you go online often at home?..... 74

Figure 4.19: Willingness to pay extra for additional electronically delivered services.... 76

Figure 4.20: Template for incorporating features into teacher websites 83

Figure 4.21: Template for incorporating features into student websites 84

Figure 4.22: Screenshot of Main Teacher Page 86

Figure 4.23: Screenshot of the Main Student Page 87

Executive Summary

With the advent of new electronic media, the field of science education has seen new technologies as a way to get more information to students while keeping the costs of textbooks and other materials down. Around the world, new uses of electronic media such as web-based learning and other supplements to traditional instruction have become the future of education.

The Commonwealth Scientific and Industrial Research Organization's Education Branch (CSIRO Education) in Victoria wanted to take advantage of this new wave of education and electronic media in order to best serve the students and teachers of Victoria but the staff were not sure how electronic media could be used best to add value to CSIRO Education's programs. CSIRO Education wanted to identify what kinds of new electronic media are available and understand how these advances could be applied to CSIRO Education programs.

Our first objective was to evaluate and assess the various types of electronic media that have been successfully used in education by others. Our next objective was to determine the needs of the customers of CSIRO Education: the educators of Victoria. After determining the wishes of these teachers, we needed to discover methods to market electronic media. Finally we wanted to investigate the use of electronic media to supplement CSIRO Education's programs by incorporating the suggestions and opinions obtained from teachers. For all of these stages, we were cognizant of the wishes of CSIRO Education and its customers that were revealed in our research.

Initial project work involved background research on electronic media in order to determine possible uses of electronic media for education. We determined what uses of electronic media would be practical for CSIRO Education by discovering how

CSIRO Education operates and established the most appropriate forms of electronic media from our background research.

We evaluated the needs of teachers in Australia by conducting surveys and focus groups. Through communication with teachers in Victoria, we gained an understanding of what makes electronic media desirable for educational use. Since the students' satisfaction influences the teachers' decisions, a student survey was also conducted in order to get the students' feedback on electronic media. In order to fully understand CSIRO Education's programs we observed several of its live educational presentations for students and even participated in one of them. With this understanding of the education programs, we were able to create a website template for incorporating electronic media into CSIRO Education programs.

The data gathered from the teacher survey were analyzed by considering the responses of teachers who have recently booked CSIRO Education programs and teachers who have not. In addition we analyzed the data by comparing the responses from the three school types that exist in Victoria (Government, Independent, and Catholic). From the teachers' responses and comments on the questionnaire and their feedback from the focus groups, we determined that neither school type nor whether or not a teacher had used CSIRO Education programs in the recent past altered a teacher's opinions substantially. The student survey reinforced the results of the teacher survey by demonstrating the students' feelings about computers and the Internet, which were generally very positive. Since many teachers noted on the survey and in focus groups that cost was a big issue with booking CSIRO Education extension programs, the benefit provided by electronically supplementing a program will allow CSIRO Education to provide a greater value to teachers. Providing information electronically can also minimize the time and money spent traveling by

both teachers and CSIRO presenters. Providing information electronically will also save time during presentations by not presenting background material.

Once we determined the type of electronic media that was desired and most practical, we identified some of the basic factors that might be involved in marketing programs delivered by this electronic medium. Since an interactive website was the clear favorite amongst the teachers, we contacted developers of websites and found that there is a wide range of complexity available when designing a website, with more complex sites being more expensive to produce. While very cheap web development options are available, we determined that these would be difficult to market to Victorian teachers because they would not contain the professionally developed interactive multimedia for students that teachers want. In order to fulfill the desires of Victorian teachers for electronic delivery, we have recommended that CSIRO Education should invest in an interactive website with elements such as discussion boards which were requested by a majority of teachers surveyed.

Finally, we have made suggestions on how CSIRO Education can incorporate electronic media into its current programs. We developed a sample website for the “Energy and its Uses” education program as a template to use when supplementing CSIRO Education’s programs. Two different websites were created: one for the teachers that provided program information in a more formal setting and another site for students that emphasized interactivity and responded to the desires of students as expressed in our student survey results. On the student website, there are links for interactive animations, videos, an example of an assessment exercise, and a discussion board which would be included in the future. These aspects of the website, typically unavailable with traditional CSIRO Education programs, would provide added value to CSIRO Education programs.

Our research led us to conclude that electronic media would be best utilized to deliver follow-up materials to the teachers and students who use CSIRO Education's programs. Although many schools do not have reliable Internet access, the majority of Victorian schoolteachers would prefer to have follow-up materials delivered on a website. These materials should include background information and topic plans for the teachers and interactive materials for the students to use. Although it is impossible to provide specific costs without knowing the exact details of the implementation, we outlined the factors involved in producing electronic media and listed the costs involved for sample implementations. It is our hope that the principles for integrating electronic media into CSIRO Education programs that we have proposed will allow CSIRO Education to fulfill its goal of educating and exciting Australian students about science more completely.

1 Introduction

Since the days of the abacus and slide rule, educators have sought ways of incorporating new technologies into their classrooms in order to improve the overall learning environment. With the invention of electronic media including the Internet and CD-ROM's, many teachers have been eager to utilize these technologies to help students to learn. Educators see this as a way to get more information to students while keeping the costs of textbooks and other materials down. Electronic delivery allows teachers to interact and coordinate with their students in new, exciting ways. Around the world, technologies such as web-based learning and other means of supplementing education electronically have become the future of education. As more and more educators use these methods, many organizations desire to ensure that they are using these technologies to their greatest benefit.

The Commonwealth Scientific and Industrial Research Organization's Education branch (CSIRO Education) is an important force in the promotion of scientific careers within Australia. Like other organizations involved in education, they desire to stay at the forefront of the field by embracing new technologies that may add value to their programs. The staff of the CSIRO Science Education Centre of Victoria desire to utilize electronic media so that they can best serve the state of Victoria, but they are not sure which media would be most helpful in achieving this goal.

In the recent past, educators have used electronic media to enhance learning in many different ways. For example, in China, distance learning has been used to provide a higher level of instruction to students in remote locations who would otherwise not be able to access the programs involved. Other research has found that interactive computer programs are a great way to motivate children. In Victoria,

Australia, electronic technologies have also been used to reach out to rural students for whom commuting to the nearest school is difficult. In these ways, the educational needs of students are being met through the use of electronic media. In each of the cases above, researchers identified the needs of an education program and its clients, determined the costs involved, and then designed and implemented an electronic system that best fulfilled their needs. Through this work, technology has been able to provide specific solutions for a variety of education needs that would have been extremely difficult to solve through traditional methods.

Although previous implementations can provide useful insights when exploring the use of electronic media, this previous research does not take into account the specific needs of CSIRO Education programs. CSIRO Education knows that it wants to supplement its programs with electronic components but is not sure about the particular methods to use and their advantages and disadvantages.

To understand how CSIRO Education of Victoria can remain a leader in science education, we have explored what the newest and most effective methods of teaching with electronic media are. Our Interactive Qualifying Project (IQP) builds upon the work of previous researchers in order to determine how CSIRO Education Officers can best motivate their students to enjoy science by using electronic media. Our work focused on what others have done, what is possible, and what CSIRO Education can effectively implement. Since our sponsor's customers are teachers and educators, the input of these local professionals was essential so that their needs were kept in mind when suggesting improvements specific to CSIRO Education programs. We have therefore conducted four focus groups and a survey among teachers to understand what they are looking for from CSIRO Education and how technology can better equip them to teach their students about science. In addition, our research included a survey of student attitudes toward electronic media in order to determine

what benefits they feel they can receive by learning electronically. Our surveys and focus groups helped us to formulate not only possible technological solutions, but also a marketing strategy to increase participation in CSIRO Education programs among Victorian schools. Our project also delivers our recommendations as to how the technologies available in Australia can be used in conjunction with CSIRO Education programs. It is our hope that these strategies and suggestions will allow CSIRO Education to better educate the children of Victoria.

2 Literature Review

The staff at CSIRO Education believes that its education programs may benefit from electronically delivered components, including websites and CD-ROMs. We will review previous research that has examined how students are motivated to learn best, and how electronic media can be used in education programs. In addition, electronic media have been incorporated into many different education programs. These past studies provide excellent insight into what CSIRO Education can accomplish by implementing electronically enhanced components into their education programs.

2.1 Motivating Students to Learn

Motivating students to learn has always been a challenge in education. CSIRO Education aims not only to encourage students to participate in scientific activities but also to go beyond that and encourage children to consider careers in a scientific field (CSIRO Education, 2003, Main Page). The fulfillment of these goals can be affected by issues associated with student motivation, and more specifically, how to motivate students to the point where they enjoy what they are doing. This problem is a difficult one; Diane Halpern (2002) in an article on long-term learning stated, “The science of learning is as multifaceted as the learners themselves” (p. 3).

There are many reasons why students are often not motivated to learn. These may include teaching methods that the students do not respond well to or topics that the students simply do not find very interesting. While these aspects may be contributing factors to the student’s attitude, John Keller (1999) says that, “Ultimately, each human being is responsible for his or her motivational condition, but it is abundantly clear that the environment can have a strong impact on both the

direction and intensity of a person's motivation" (p 11). Thus, the environment in which a student learns contributes to the student's level of motivation. To create an environment that will motivate and excite students, information relevant to the learners themselves helps create a learning environment where students enjoy their education.

To understand what excites and motivates students to learn, it is important to know that "although students may be equally motivated to perform a task, the sources of their motivation may differ" (Lumsden, 1994). Carol Dweck (2000), a leader in the area of motivation in learning, claims that: "Too many students are hung up on grades and on proving their worth through grades. Grades are important, but learning is more important." CSIRO Education aims to encourage children to learn because they enjoy the topics, not because of a drive to gain high grades. In looking for ways to add value to CSIRO Education programs, we examined electronic media systems that could create a learning environment in which students enjoyed learning about the subject matter rather than being concerned with grades.

2.1.1 Motivating with ARCS

ARCS, which stands for attention, relevance, confidence, and satisfaction, has been proposed as a framework to motivate students by many researchers (Keller, 1999, p 3). Many consider that ARCS comprise the four dimensions of motivation that should be emphasized in learning situations to increase student motivation. This model for motivating students has been used in many different learning situations whether through electronic media or in traditional classroom settings. In Japan, this model was used as part of a national project to develop computer applications for different school subjects. After some modifications, the project was given a huge boost by tracking what motivated the students and what did not along with how this

motivation affected their learning. By tracking the positive and negative motivation shown by the students, researchers were better equipped to show how well the students were learning the information (Keller, 1999, p 4). This is a necessary consideration when dealing with electronic media in education, since there is often no teacher present to track the motivation of the students. While ARCS is more theoretical in nature, there are other solutions that focus more on the social aspects of learning.

2.1.2 Motivating through Mentoring

Mentoring is a well-known concept in the business world and on some college campuses where it has a positive impact on student career development. While this concept may seem unrelated to implementing electronic media into CSIRO Education programs, the ideas behind mentoring are actually very relevant to this challenge. In a study on the effects of mentoring on undergraduates in a college setting, Brian Coppola (2001) states “Mentors directly affect how the next generation of mentors will behave” (p 5). This principle is similar to the goals of CSIRO Education: to see the younger generation become excited about science in the same way that CSIRO Education Officers are and moreover to have these students become the next generation of people working in science-related fields. Mentors develop relationships with people. While a CSIRO Education presenter has limited time during a presentation, they can still become mentors. As Coppola (2001) puts it, “Above other things, mentors are obliged to help students uncover their dreams and realize their potentials” (p 1). This can be achieved through demonstrations that capture the imagination of students, and encourage them to continue studying the topic after the presentation.

People making career choices are often guided by the remembrance of a time spent truly enjoying something. By supplementing CSIRO Education programs with electronically delivered follow-up materials, the presentations delivered by CSIRO Education Officers can be better remembered, thus having a greater impact on the students. CSIRO Education staff become active participants in a child's education by holding their attention with demonstrations and experiments that not only increase the students' motivation to learn, but also create a lasting memory of the event.

By having students "learn by doing, making, writing, designing, creating, solving," their level of motivation increases (Davis, 1993, General Strategies). Mentoring allows for this hands-on learning that is necessary to motivate students. Since "passivity dampens students' motivation and curiosity," it is important to keep the students involved in their learning (Davis, 1993, General Strategies).

Increased motivation and lasting memories achieved through these approaches would become even more important if the learning took place through electronic media, since these benefits could be distributed to many more students. Often, the motivation for students to continue with an electronically delivered program must come from within themselves. CSIRO Education is fortunate in that it can count on a teacher being there to constantly encourage the students to participate in the electronically delivered program. Once basic motivation exists in the student, the program itself must then have enough interesting and interactive information to hold their interest.

2.2 Electronic Education Programs

Existing electronic education programs and the associated issues faced by previous researchers were examined to determine the best form of electronic media to

supplement CSIRO Education's programs. Several common methods of supplying information electronically exist, including e-mail, CD-ROM, and websites.

2.2.1 Potential Delivery Methods

There are many benefits to the electronic delivery of educational materials, whether it is through the Internet or through material on a CD-ROM (Castro, et al., 2001, pp. 406-411). By presenting information through different forms of media, electronic delivery provides this information in a way that stimulates different senses, thus allowing for students with different learning styles to be accommodated within the same program. Collaborative learning skills also benefit, since the users of these programs often share a computer or communicate with others via the Internet (Castro, et al., 2001, pp. 406-411). Since CSIRO Education's demonstration-based programs are typically interesting to children, electronic components can be especially useful as introductory or follow-up methods to these programs (Rebecca Carter, personal communication, April 14, 2004).

E-mail Delivery

E-mail is a commonly used way of supplementing an education program. It is usually used to distribute assignments but can also be used to send out actual course materials, although this might be done better through a web site. An email system that specifies an address to which questions can be sent could be an effective electronic method for following up CSIRO Education's live classes, because children who think of questions after a presentation could ask for specific answers even after the CSIRO educator leaves.

A study of programs supplemented by the use of e-mail led to the development of several recommendations for using this form of electronic media to

assist educational programs in general (Yu & Yu, 2002, p. 123). The program used in this study utilized e-mail for three main purposes: to distribute material for class discussion in advance, to remind students of their assignments, and as a fast access channel to the professor and teaching aides. The first recommendation made by the study was that the teachers of classes should be vigilant in responding promptly to any e-mail sent to them, as this will encourage students to utilize the email system more often. Also, before an e-mail system is used, one should ensure that everyone in the class has access to the technologies necessary to access the system, in order to be fair to all students. Third, the study suggests that an orientation session should be given to everyone on how to use e-mail so lack of knowledge is not a hindrance in using the system. Finally, some sort of protection against computer viruses should be put into place to ensure that no damage occurs from e-mails related to the program. Through using these guidelines, CSIRO Education can effectively implement an email component to their presentations.

Intelligent Tutoring Systems

Intelligent Tutoring Systems (ITS) are one of the most advanced forms of electronic education. If created in the correct way they can almost replace a teacher altogether, and the students can learn on their own from their computer at home with little interaction with an instructor. (Dr. Neil Heffernan, personal communication, February 20, 2004) Dr. Neil Heffernan, a computer science professor at Worcester Polytechnic Institute, created an ITS that is designed for teaching 8th grade algebra. The ITS presents a problem to the user, allows the student to answer the question, and then records how many attempts it takes for the student to get the correct answer. In the process of answering the question there are help notes that appear when one incorrectly answers the question and also a help button that the students can use when

they feel the need. These systems are expensive: Dr. Heffernan is currently working on a team of 6 researchers building an ITS that is funded by a grant of US\$1.4 million. These systems prove just how far electronic media can penetrate into the educational process, although CSIRO Education would probably not use such systems because of their development costs and the fact that they are designed to actually replace instructors, not to supplement them.

CD-ROM Delivery

A widely used method of delivering education materials is as computer programs on CD-ROMs. A study of 62 eight-year-old children examined the amount of information that children retained after working in pairs with interactive books on CD-ROM (Underwood & Underwood, 1998, pp. 95-101). They found that while this form of education mixed with entertainment does capture children's minds better, the ultimate predictor of retained knowledge was the reading ability of each individual child. This study helps us focus on the fact that no matter how visually impressive the electronic media are, the information delivered is still what makes a program successful.

World Wide Web Delivery

Perhaps the most viable option for the delivery of educational materials is having them available on the World Wide Web. The Internet is easy to access, and hosting prices typically range from AUD\$8 – AUD\$110 per month, depending on the type and amount of information that needs to be sent to and from the site (Oxxus, 2004, "Web Hosting Plans," West Australian Networks, 2004, "Web Hosting"). However, several potential barriers exist with implementing a Web-based education program. A study of European educators who were experimenting with a Web-based extension education program for meteorologists found that although concerns were

not commonplace, they did exist among the people involved in the program (Phelps & Reynolds, 2001, p. 212). The educators who reported their concerns before the trial run of the program said they worried that an online learning system would not be as effective as personal instruction at getting the meteorologists to learn, while the meteorologists themselves reported after the trial run that the online system needed to be made more reliable in the final product. These questions of effectiveness by the teachers and suggestions by the learners that the online system always function properly provide valuable opinions that should be taken into consideration when producing a web-based education program.

2.2.2 Principles of Distance Learning

A possible application of electronic delivery of CSIRO Education programs would be reaching out to students who normally could not participate in CSIRO Education programs because of geographical distances (see Section 5.2.3). These distances make it difficult to teach children in rural areas because of the travel time necessary for CSIRO Education presenters. However, according to Moore's Theory of Transactional Distance (1996), a psychological and communications gap always exists between any teacher and student. This "transactional distance" can be measured in terms of the structure and the dialogue provided by the education program. The structure of the program is the degree to which the students follow a set program of education as prescribed by the teacher, and the dialogue is the amount of information exchanged between student and teacher. Whether it is a distance learning program or not, if there is a low amount of structure and a low amount of dialogue, the program will have a high transactional distance, which is detrimental to learning. In the design of an electronically delivered education program component, one must ensure that it

stays structured and, most importantly, that communication is encouraged and happens often.

In an interview with Professor Karen Lemone, a distance learning educator at Worcester Polytechnic Institute, several aspects of electronic programs were discussed (personal communication, February 23, 2004). First of all, although analytical and theoretical material is harder to learn online, in general the method of presenting information to students is more important than the information itself. This means that when recommending the use of electronic components to CSIRO Education programs, the most important aspect to consider is ensuring that this presentation is interesting and understandable to children. To produce the kinds of animations and interactive programs that children find enjoyable, CSIRO Education would have to employ professional multimedia development companies, who are the only people who have the expertise to design these programs. In addition, Professor Lemone stated that using e-mail supplements would not be a good method of delivering new interactive material to children because a large program should not be sent to someone's inbox. Rather, e-mails should be used to inform children or teachers of updates to a Web site for the program. Then, they could simply navigate to the online Web page and participate in an online chat or read an updated online newsletter that CSIRO's publishing branch could put out. Finally, Professor Lemone cited the marketing program of the University of Phoenix, a premier distance-learning institution in the U.S., as an excellent model for marketing CSIRO Education programs. This institution uses some Internet promotion but primarily bases its marketing strategy on traditional advertisements on TV and brochures it sends to potential consumers of its programs.



Karen A. Lemone –
Computer Science
Professor at Worcester
Polytechnic Institute (WPI)
(Source: WPI Website)

2.2.3 Applications of Technology in Educational Systems

A study of how well middle school children learned online versus in the classroom found that electronic learning is most effective when it is combined with personal instruction from a teacher, who clearly outlines the expectations for the class and aids the children with the initial use of the online interface (Hoffman, et al., 2003, p. 342). This is good news for CSIRO Education, because from the beginning of this project, they have planned to simply incorporate an electronic component into their existing education programs, in which an instructor is already primarily responsible for the children's learning.

Elsabé Cloete, a professor in the Department of Computer Technology and Information Science at the University of South Africa, has developed a complete pre-established general model of an electronic education program, outlining all of the different aspects that a good electronic system must have, and demonstrating how to apply the model to a specific situation (Cloete, 2001, pp. 171-182). This model was considered when recommending electronic components for CSIRO Education programs.

Within this model, there are four layers to the education program, each of which contains several different aspects of the program that must be considered. First, there is the *Instructional* layer, which includes the choices of learning method, course layout, and other aspects of a program that would be up to the instructor. Second, there is the *Educational Middleware* layer, which includes the electronic support tools that are necessary for the program. These are logistical issues such as electronic assignment submission, data storage, and other administrative capabilities that should or should not be included. Next, there is the *Electronic Paradigm* layer, which determines the actual strategy for the electronic program. This strategy can be synchronous, in which classes are conducted online in real-time, or asynchronous, in

which class work is done independently. Implementations such as chat rooms and online materials lend themselves to real-time education, while methods such as CD-ROMs, downloadable information, and bulletin boards are more convenient for an asynchronous program. Finally, there is the *Physical* layer, which simply treats matters of software and hardware specifications. The advantage to using this general model is that in order to design a specific education program, all one has to do is design it from either the top down, starting with the *Instructional* Layer, or from the bottom up, starting with the *Physical* layer. The choice of where to start designing can be made based on what resources are available. For example, if there are many willing teachers, but few physical resources, the program should be designed based on the amount of physical resources that are available.

2.2.4 Existing Delivery Systems in Australia

One focal point in our study was to research existing educational CD's and websites in Australia. We did this in order to find out how current leaders in technology use the World Wide Web and CD's to convey educational information. We visited the CSIRO Publishing website to look at a few different CD's. We were not able to view the actual CD's, but we were able to read a little description about each CD, which showed us that the information on the CD's was not directly related to the education programs offered by CSIRO Education of Victoria. From the descriptions of the CD's that we read, we concluded that the CD's might provide some sort of background material to CSIRO Education programs. A few of the CD's contain interactive programs and some come with booklets containing activities relating to the topic on the CD. The CD's are designed to educate people about a scientific topic. An example



of a CD would be “The Bay”, which is an interactive program where the participant manages a bay ecosystem for ten years and encounters different scenarios. At the end of the ten years, the player is supposed to try and finish with the bay being as healthy as possible. As far as the price goes, these CD’s range from about AUD\$20-100 but the majority are AUD\$50 and above. These CD’s are an excellent example of how CD’s are currently used to deliver education programs (CSIRO Publishing, 2004).

We also looked into a website created by the Victorian Department of Education, called Sofweb, which uses the latest web-based technologies, to aid the learning of Victoria’s youth. Sofweb provides background information to the teachers and students of Victoria in order to help them achieve their educational goals. Sofweb also provides teachers and students with the chance to participate in online discussion groups and the ability to join a networked classroom. Sofweb is a successful website having 5.000 visitors daily and over 30,000 web pages accessed each school day. Sofweb is a good example of successfully using electronic media in education and is a prime example of how CSIRO Education could implement electronic media in their current educational programs (State of Victoria Department of Education and Training, 2002).

2.3 Case Studies of Electronic Education Programs

Today’s educational landscape is covered with the effects of technology. In schools around the world, electronic delivery of educational materials is becoming a viable option for many educators due to recent advances in technology. The business school of the Massachusetts Institute of Technology, known as the Sloan Institute, utilizes the Internet in its education programs. This leader in online learning claims that “nearly one-third of academic leaders expect that learning outcomes for online education will be superior to face-to-face instruction in three years, and nearly three-

quarters of them expect learning outcomes for online education to be equal to or better than face-to-face instruction” (Allen & Seaman, 2003, p.6). This belief has led many people to try to incorporate online and distance learning into their curricula and programs.

2.3.1 Chinese Modern Distance Education Project

In China, the government has begun an initiative called the “Modern Distance Education Project” which has used the exponential growth in information and communication technologies to make web-based learning an “increasingly popular instructional mode” in schools (Zhang, et al., 2002, Web-Based Education at Conventional Universities). They use two different learning approaches in their web-based courses: “distance real-time instruction mode” and “distance self-study courseware instruction mode” (Zhang, et al., 2002, The Course Subsystem). They use various modes of transmission of their course materials, including print materials, CD’s, and websites. They give their students a choice when deciding which medium will be easiest to access. The results of this Modern Distance Education Project are very encouraging. As Zhang puts it, “With the introduction of the Web-based instructional mode, teachers and students now find the multimedia course materials more interesting and stimulating. Students have more autonomy in their own learning, and teachers play a more significant role as facilitators” (Zhang, et al., 2002, Intended Consequences). The example also shows that successful online courses benefit from support by many different media, not just the Internet. CD-ROM software as well as paper materials and tutorial centers have been shown to improve the quality of online education (Zhang, et al., 2002, Discernable Trends).

The only problems encountered with this type of education have been those of lack of knowledge and availability of computer technology in China. Since most

people are not able to afford the necessary technology, the effectiveness of the learning is limited. Also, teachers who are not used to teaching across the Internet or with other electronic media have had trouble adapting to the “online” environment (Zhang, et al. 2002, Unintended Consequences and Problems Encountered). Overall, Zhang considered the effectiveness of the methods used in China to be exceptional, and the use of electronic media has revolutionized the Chinese educational system. It has the potential to bring a country of over a billion people the means to get a quality education in the future, once the majority of the people gain Internet access. The powerful potential of electronic media can be put to work for CSIRO Education as well.

2.3.2 Web-based Education in Catalonia (Spain)

While China needed to find a way to educate its huge population, Catalonia in Spain, needed to provide a way for busy people to fit a quality education into their schedules. In order to achieve all the goals set out by the Catalan government, the model used to develop their web-based education had to incorporate the rich culture of the area and perpetuate the language and history to the next generation. Along with reinventing their educational structure, they created a system called “Campus Virtual,” which created an environment where students could interact with other students and receive personal attention from the staff of the university (Sangra, 2002, UoC Virtual Campus and its infrastructure). The university uses a variety of electronic media to try to keep its students in touch with their coursework. For the university, “the ideal is to create a learning system where students not only acquire knowledge and build their skills, but also learn how to learn. Essential to attainment of this ideal is high quality materials that are carefully designed to be dynamic, intuitive and self-explanatory for students working within a distance education

environment” (Sangra, 2002, Continuous Assessment). Through their “Campus Virtual”, the university was able to meet its needs of simplicity and ease of communication while incorporating the rich culture of its region. This example demonstrates the ability of distance learning to teach students how to learn, increasing their ability to go beyond the curriculum and learn on their own.

2.3.3 Distributing Complex Drawings Electronically

In another study dealing with the use of a Web page for the electrical engineering department of a university, the Web designers faced a different problem (Al-Nuaimy, Zhang, and Noble, 2001, p. 116). For their online courses, complex scientific models of electrical circuits had to be constructed and run according to data entered by the student. These models, originally implemented as a Java Applet, were too large to be practically run on the user’s computer. The designers instead utilized a Matlab-based Web server and used Common Gateway Interface (CGI) programs. These programs provided an interactive environment similar to the familiar Java applets for the user, but run on the Web server instead of the user’s computer. This allowed the Web server to accomplish all of the complex number crunching, taking the burden from the user’s computer. This method of displaying complex graphics and animations, common to CSIRO Education’s programs, is yet another technology that could be considered for electronic implementations of CSIRO Education programs in the future.

2.3.4 Study of Regents College

Another study about web-based systems was completed by part-time students at Regents College in Albany, NY. This system is set up for adults who wish to complete their degree at their own pace. Over the last few years the college has

established electronic advising, an electronic peer network, a virtual library, an online bookstore, a web-delivered database of distance courses, and an online alumni service. They have encountered some problems with their online system, such as the “provision and allocation of resources, the availability of appropriate technological infrastructure, organizational structures and procedures, service quality, student access and equity” (Brigham, 2001, “Problems and Issues”). A committee at Regents College addressed these problems as shown in the following table, which gives a timeline of when the college accomplished its goals in converting to an online-based system.

Table 1. Service Conversion Time Line

Service	Date	Time required	Approach
Advising	10/97	7 months	In-house
Electronic Peer Network	5/98	15 months	In-house
DistanceLearn	7/99	1 year	Outsource
Bookstore	8/99	1 year	Outsource
Library	2/99	1 year	Outsource
Alumni	7/00	4 months	Outsource

(Source: Brigham, 2001, “Problems and Issues”)

Advising is an important part of the educational process, and since the college was converting to web-based education, it wanted to make sure that students could still communicate with advisors. The college wanted to set up an e-mail system for the students to contact advisors, and after evaluating various software packages they chose Lotus Notes. This gave them the ability to have team e-mail boxes where a team of advisors could all view and collaborate on a single student’s issue. The Electronic Peer Network was created so that students could contact other students, faculty, or staff members when they needed help. Regents College decided to build a

website for the students so that they could locate study partners, join online study groups, chat with other students and staff, and access resources related to their programs and career goals (Brigham, 2001, “Advising”). CSIRO Education should consider ideas such as this, in which students interact with each other, along with normal learning methods involving teachers and students.

DistanceLearn is an electronic database set up by colleges to list all of the online courses available between the schools. There are over 16,500 courses currently listed on the website so that students can choose what classes they want to take. The online bookstore and library were established to give the students a rapid and reliable method of acquiring study materials twenty-four hours a day, seven days a week. This is important for online education so that the students can obtain educational material quickly and when they need it (Brigham. 2001, Converting Student Support Services to Online Delivery). This type of informational website could find applications in the marketing of a CSIRO Education program.

2.3.5 Distance Learning at WPI

The Academic Technology Center (ATC) at Worcester Polytechnic Institute (WPI) often works with methods of getting information across large distances to students. Pamela Shelley, a staff member with the ATC, gave our team some feedback as to the different methods of approaching distance education (personal communication, February 13, 2004). In the late 1990’s, e-mail started to be used to transfer information in distance learning courses. Approximately four years ago, videos started to be streamed on the Internet, thereby replacing the previous method of sending tapes to the students off campus. These videos allow the students to view exactly what the teacher does in class in order to aid them in their learning experience. This could potentially be used so that students could replay a

demonstration brought to their school by CSIRO Education, or could even view CSIRO Education programs in remote areas to which CSIRO Education presenters could not normally travel.

Simulations using technologies such as Flash are helpful to the students but are often expensive to set up. Pamela Shelley thought that using these expensive technologies might be educationally worthwhile if it was for a basic course that many students were going to use over and over again. She told us that the same information that could be sent over the Internet could be put on a CD, but in general, a CD would only be used when the students did not have enough bandwidth for the information being provided on the Internet. Shelley also told us that in terms of marketing technology, it is best to market the benefits of the technology rather than the technology itself. Our talk with Shelley suggests that CSIRO Education should concentrate its promotion on the benefits of these new electronic components, and should not emphasize the details of the technology itself.

2.3.6 Distance Education in Australia

Electronic forms of education have already been tested in parts of Australia. In Australia's largest state of Western Australia, the School of Isolated and Distance Education implemented a videoconferencing system in order to deliver "accessible and high-quality education" to all of its students (T.H.E. Journal, 1998, p. 44). The experiment was very successful and was said to have provided a "richer, more exciting learning experience." It even increased the rates of retaining students in the schools where it was implemented, making videoconferencing an attractive method of teaching students.

Applications in the State of Victoria

In Victoria, the state school system faced the problem of keeping its rural students enrolled in school (T.H.E. Journal, 1994, pp. 56-59). It implemented a somewhat more complex videoconferencing system that used Macintosh software called “Electronic Classroom.” This software, combined with a standard telephone link, allowed for audio information to be transferred in real-time over the phone, while video was sent between computers. The video content included not only footage of what the teacher was doing at the time, but also included a live electronic chalkboard, which the teachers used and the students viewed. In addition to the primary teacher who taught the material, there was always a secondary teacher on site for clarification of material and to enforce discipline. The results of this trial were also very positive. The nature of the real-time online course forced both students and teachers to be very well-prepared before each class. Perhaps best of all, the study found that students were more open in the online class, because they could ask questions anonymously online, and because the class was specifically designed to involve each student’s interaction through his or her own computer terminal. The disadvantage to a real-time system such as this is that each student must have his or her own computer terminal for it to work, and these kinds of resources are not available in many Victorian schools.

University of South Australia

Since 1993, the University of Southern Australia (UniSA) has been converting its non-online programs to online programs. Its goals are to achieve: “ (a) recognition of the significance of information and communications technologies in supporting student access and learning; (b) the formulation of an overarching teaching and learning framework that informs and directs the development of online learning; and

(c) the resourcing of equipment, systems and infrastructure to support widespread use of these technologies in program delivery” (King, et al., 2001, Overview of Efforts).

For UniSA, an important part of being able to teach online was to strengthen the electronic-network between campuses. A common email environment between staff and students was also created using Microsoft Exchange. Another critical step in the development of the online education program was to create a simple platform that could be used by the teacher without any technical training or help from a technical expert. UniSAnet was formed using a variety of tools and wizards, which aids the teachers and students so that they would not need any help from an expert. UniSAnet was designed so that it was no harder to use than a common program such as Microsoft Word. This then enables the academic staff to concentrate efforts on pedagogical issues rather than technical skills. One downside of the system is that a high speed Internet connection with a high bandwidth is required to get the complete experience with all the graphics included. For now UniSA has chosen to eliminate graphics and images that may cause problems. The success of UniSAnet is primarily due to students accepting the role of online education (King et al. 2001, Unisa’s Approach). Considering this finding, it is important for CSIRO Education to communicate with students in Victoria to ascertain their acceptance of online forms of education.

The studies of electronic education in Australia primarily serve to confirm CSIRO educators’ belief that an electronic component could add value to their programs. Australians in general are prepared to utilize such methods as part of their education, as evidenced by the success of these previously mentioned programs. The programs also specifically demonstrate the success of videoconferencing as an educational method. While CSIRO Education’s programs are mainly based on a live demonstration and interactions, supplements employing CD’s, a website,

videoconferencing or streaming video might be considered as ways of reaching schools that would not normally book CSIRO Education's traveling education programs because of the traveling distance or costs involved.

2.3.7 Student Attitudes toward Distance Learning

Noting that Web-based education is quickly becoming a dominant form of teaching in many disciplines, Vicki L. Gregory, Director of the School of Library and Information Science at the University of South Florida, conducted a study of student attitudes toward this form of education (Gregory, 2003, pp. 426-431). This research consisted of a survey given to students at the University of South Florida who took Information Science courses, in which they were asked to rate the course on a 5-point scale. Some students took a course by a particular professor that was taught entirely online, and others took the same course by the same professor, but were taught in a more conventional manner, with an online component taking a supplementary role. Five professors and their courses were evaluated in total.

In four out of the five cases, the students rated the classes with some form of real-time interaction with the professor as being much better than their entirely Web-based counterparts, and in the other case, the students simply did not seem to care for the professor's face-to-face teaching method (Gregory, 2003, p. 429). However, students felt that this form of interaction did not necessarily have to be in person in order to be effective. Rather, the study found that courses that are perceived by students to be better are those that include any form of real-time interaction, whether that interaction is meeting the professor face-to-face or in an online chat room. Gregory concludes by stating that although online education has cost benefits and is convenient, Web-based courses must be enriched through the inclusion of some form of instructor/student interaction (Gregory, 2003, p. 429). This is useful information

for CSIRO educators, who still plan to use live demonstrations as the main part of their programs. This also suggests that in an electronic version of a follow-up program, scheduled interactive chat sessions or online bulletin boards could be excellent ways to provide students with more information about the topics covered during the hands-on part. For this to be worthwhile, CSIRO Education would have to be guaranteed enough student participation in these online sessions.

2.3.8 Teachers' Attitudes on Distance Learning

A much larger study than Gregory's study of students was conducted by Robert Newton of the Aberdeen Business School in the UK (Newton, 2003, pp. 412-425). This study consisted of a literature review, a questionnaire with 134 respondents, 16 interviews, and 11 e-mails from academic professionals. It found that although most teachers do recognize that an online component to education is valuable, especially because it can reach out to students who live far from campus, the teachers do have several reservations about the method of delivery. First, if it is unclear how to use the Web effectively for teaching, or if they feel that they must design the Web portion of the course themselves, they are likely to shy away from this approach. In addition, there is generally no perceived benefit to the teachers for making this time-consuming shift, so they would often prefer to keep using their old methods. Finally, many educators, particularly those of the older generation, are not convinced that online education can do the job right, and see it as a cheap replacement for traditional teaching. From this we learn that care must be taken to make the teachers who are CSIRO Education's customers aware of the benefits of online education, and to demonstrate these benefits to them in a very specific manner when an online component to a CSIRO Education program is introduced.

2.3.9 Case Study Conclusions

The case studies that our team investigated were selected for their relevance to our project. All of these studies show how other colleges and organizations have used the web to deliver educational classes and support material. These case studies serve to give CSIRO Education a basic idea of how electronic components have been used in the past to supplement educational programs and how entire courses have been provided online. In general, the research shows that electronic education is a very viable option for adding value to CSIRO Education programs. Students seem to perform well when enrolled in an electronic education program, suggesting that it is an effective and powerful learning tool. Most of the technological problems in the past have been solved in creative ways, and the remaining issues include convincing some teachers that electronic education is appropriate and integrating live teaching with electronic teaching. It is therefore extremely important to use a blended learning approach by combining electronic components with an instructor who still interacts with the students in real time. By taking these aspects of previous electronic programs into account, CSIRO Education can design an effective program of its own.

2.4 Marketing Technology

The marketing of any one product can be thought of as a “marketing mix” composed of four different factors (Kasouf, personal communication, January 16, 2004). The first factor is the product itself. It must have attributes that appeal to the intended consumers, or they will not want to buy it. The second factor, the price of the product, must be set at a level that is not only low enough to be a good value to the customer, but is high enough to reflect the worth of the product and to yield a profit. The next factor is the advertisement of the product. Its attributes must be made known to consumers within the targeted market segment so that they can decide if it is right

for them. For the last factor of the marketing mix, the product must be distributed in such a way that reflects its worth, and also so that consumers can access it (Kasouf, personal communication, January 16, 2004). CSIRO Education will have to consider all of these factors when marketing electronically enhanced programs.

In general, the normal marketing mix applies to CSIRO Education's programs, but there are several principles of marketing that apply specifically to high-technology services such as an electronically enhanced education program. First of all, some sort of differentiation from competitors' products should be built into the new education components at the concept stage (Sowter, 2000, p. 189). Mass customization is "the low-cost, high-quality delivery of individually customized goods and services," and has been found to yield a substantial edge over competitors in the technology-oriented marketplace (Heilbrunn, 1995, p. 8). In the market for new technology, the concept of mass customization is extremely important. Electronic media can help CSIRO Education provide this to its customers, because online, the presentation of information can be quickly manipulated and adjusted to conform to individual preferences.

After finalizing electronic components for their programs and testing them with its current customers, CSIRO Education will be equipped to find new markets for its services because it may be able to reach out to new customers (see Section 2.3.6.2). This can yield substantial additional returns at a low cost by reaching out to customers who were previously unreachable because of geographic distances (Sowter, 2000, p. 189). With the customization that is required for technological marketing, it is even more important than usual for CSIRO Education to recognize the needs of its customers and incorporate them into the final product.

3 Methodology

The goal of our project was to inform CSIRO Education of the range of possibilities for augmenting its current extension education programs using electronic media. The research methods we chose helped us to ascertain this information and indicated how to market these new additions to their already popular programs. To accomplish our goal, we used a mixture of surveys, focus groups, observational research, and interviews.

3.1 Users' Opinions on Electronic Media in CSIRO

Education Programs

In order to accurately get a feel for what the teachers of Victoria want in the education programs of CSIRO Education we chose to question a sample group of relevant teachers. Since it is primary school teachers and secondary school science teachers who actually book the programs, their needs were paramount in deciding on the best form of electronic media for CSIRO Education to use. We used two methods of data collection to assess the opinions of teachers in Victoria: surveys and focus groups. Surveys were useful tools for our study because they allowed us to gather opinions from a wide variety of individuals and compile these to obtain an estimate of Victorian science teachers' feelings toward the possible use of electronic media in CSIRO Education programs. On the other hand, focus groups allowed us to gain clearer insights from a small group of educators and really question them as to exactly what content they would like to see in electronically enhanced education programs.

3.1.1 Surveying the Teachers of Victoria

Our survey needed to sample several groups of teachers. In Victoria, the three main groups of schools by governance are those owned by the government, Catholic schools, and other private schools. There are also several single-sex schools in addition to the many co-educational schools in the state. Finally, we needed to account for the fact that not all teachers have used CSIRO Education programs in the past.

We chose our sample of schools to send the questionnaire to from a database given to us by our liaison, Chris Krishna-Pillay, with all of the Victorian schools that had ever booked programs with CSIRO Education. There were 168 schools that had booked a CSIRO Education program within the last 12 months. We chose a sample of 150 of these schools by randomly eliminating 18 of the 168 in the database, and then sent our questionnaire via mail to the teacher at these schools that had booked the CSIRO Education program. With this number of samples, we sent a questionnaire to almost every teacher who had booked with CSIRO Education in the past year, giving us an excellent amount of feedback from CSIRO Education's current customers. We chose a similar sample of schools that had not booked CSIRO Education programs in the past year. We mailed a questionnaire to the science coordinator of every fifth school in the database out of 749 schools that had not recently booked with CSIRO Education, for a total of 150 sampled schools. By choosing to survey equal numbers of teachers who had booked CSIRO Education programs and those who had not booked them recently, we allowed for people who have had experience with CSIRO Education programs to critique and suggest improvements. This also allowed for teachers who haven't recently utilized CSIRO Education programs to explain why they had not chosen to use the programs in their curricula. Because we chose a random sample, the representative makeup of both sample groups in terms of the

proportion of government schools to Catholic schools to independent schools closely followed that of the population sampling frame (see Figure 3.1: Composition of Sample Groups). Mr. Krishna-Pillay advised us to send out the questionnaire early in order to reach teachers before the general school break, which for most schools stretched from Saturday, April 3, 2004 to Sunday, April 18, 2004. We therefore mailed all of the questionnaires by Wednesday, March 17, 2004.

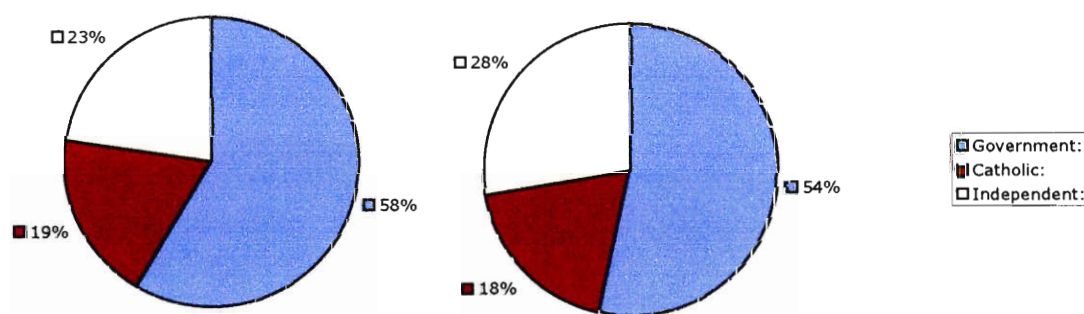


Figure 3.1: Composition of Sample Population (Right) and Overall Population (Left)

From CSIRO Education's school database, we derived our own database containing only the schools to which we had sent our questionnaire. In order to keep track of which schools had responded to our survey, we attached a unique ID number to every school in this database, and when we printed our questionnaires we made sure that this ID number was present on the actual questionnaire. This ID number allowed us to track responses while guaranteeing the confidentiality of our respondents because we did not keep track of teachers' names. Through this tracking system, we were able to keep track of the type of school (government, Catholic, or independent, and single-sex or co-educational) that each returned questionnaire was from, allowing us to analyze this dimension of our problem.

The tracking system also allowed us to follow up on schools that did not initially return a questionnaire. We called the science coordinators of schools from the group that had not booked CSIRO Education programs and politely suggested to them

that they get the questionnaire to us as soon as possible. Our phone protocol for doing this can be found in Appendix A. For the group that had booked CSIRO Education programs in the last year, we faxed another copy of the questionnaire to the science or primary teacher that had booked the program, so that if they had lost the questionnaire, they would have another copy available.

Our cover letter for the questionnaire stressed the fact that our results would be used to improve the educational value of CSIRO Education programs and allow a greater educational benefit to the students of Victoria. The questionnaire itself (see Appendix B) consisted of questions that were mostly closed format, but also included open-ended questions for the respondents to give us their own feedback. When creating the questions, we made sure that they were not too technical in nature so that the teachers could fully understand what was being asked. We asked all of the participants questions that dealt with the marketing aspects of our research as well as general questions about what types of electronic delivery would be preferable. We used a Likert scale on the first and third questions so that we could quantify the data we received. This is a numerical scale that allows the respondents to give closed answers by rating their agreement with a statement. We chose to have the teachers rank the methods of electronic delivery in question two so that we could figure out which option would be preferable for most teachers. We also left a space after question three for the teachers to tell us any other ways that they felt CSIRO Education could deliver its extension education programs electronically. In the second part of the questionnaire, we asked different questions to the people who had previously used CSIRO Education programs and to those who had not. To the teachers who had previously participated in the programs, we asked questions regarding whether they felt electronic delivery would help the overall effectiveness of the program. For the teachers who had not used CSIRO Education programs, we

asked what electronic methods would be most appealing and also questioned them about what they felt is important in an extension education program. We again used a Likert scale to gauge the opinions of the teachers on a scale of 1-5.

We pre-tested this survey with the CSIRO Education staff and some local teachers to improve the design and quality of questions in our survey. This pre-testing made us aware of a few minor grammatical errors as well as needed wording changes due to the differences in language usage between Australia and the United States. We also were asked by Mr. Krishna-Pillay to include a question dealing with teachers' willingness to pay for additional electronically delivered components. These changes were all very useful and were incorporated into the final questionnaire we sent out.

3.1.2 Focus Groups with Teachers

In order to best assess the qualities that Australian teachers would like to see in an electronically enhanced education program, we conducted focus groups with Victorian science teachers and the Education Officers of CSIRO Education. By ourselves, we certainly could not brainstorm every possible way that electronic media could be used in an educational program, so we needed to conduct some sort of exploratory research in order to gain new ideas. Focus groups are particularly suited to this kind of research, in which the most desirable qualities of a product are unknown (Bickman & Rog, 1998, p. 506).

The first important consideration when running a good focus group is having a knowledgeable moderator. In general, the moderator guides the conversation, and takes responsibility for furthering the validity of focus group results by ensuring that everyone in each group offers opinions. Also, within a focus group, the moderator has the flexibility to think of and ask questions on the spot, which in our case helped us to

clarify any new questions that were generated during our discussions. In many cases, the moderator for a focus group is an expert on the subject at hand and has worked with it for a long time. Since we could not find anyone with this kind of experience who had enough time to help us, we decided that one of us would moderate the focus groups. Before we attempted to do this, we made sure that we learned as much about teachers' feelings on electronic media in education as possible. After thoroughly reviewing our background research, examining some preliminary survey responses that we had received, and observing at least one live CSIRO Education program each (see Section 3.4, "Integrating Electronic Media"), we felt prepared to moderate our own focus groups.

All good focus group discussions require an interview guide for the moderator to follow, but since we had never conducted focus groups before, the guide became even more important than normal. This document ensured that the discussions remained focused on the topics of interest and that all of the necessary questions were discussed (Bickman & Rog, 1998, p. 513). Our interview guide for each group can be found in Appendix C. The guide included all of the questions of interest to us, and prompted the moderator on what to do during the focus groups. In practice, we were not able to ask all of the questions because we were only able to get teachers to participate for a maximum of half an hour. Therefore, we determined what our most important questions were and made absolutely sure that we discussed those topics. These important questions are written in bold type in our interview guide.

The focus groups were designed to answer the specific research question, "What are the qualities of an electronically delivered component of a CSIRO Education program that would be most important to teachers in Victoria?" The groups were each composed of five to twelve science teachers from the greater Melbourne area. By conducting four focus groups composed of different people who may have

had different views on the subject, we tried to make sure that our results were applicable to the majority of local science teachers (Bickman & Rog, 1998, p. 511). Therefore, with the help of our Liaison, we chose teachers from different types of schools, all from an area within an hour's drive from the Victorian CSIRO Education Centre. We conducted three focus groups, each composed of teachers from one of the three main categories of schools in Victoria (government, Catholic, and independent). In addition, we conducted one focus group with the employees of CSIRO Education, in order to get the opinions of these educators as well. Some of these employees are former teachers, and all of them are highly involved in education, so their feedback allowed us to learn how to add value to the educational programs of CSIRO from the perspective of the presenters.

We originally planned to persuade teachers to come to the CSIRO Science Education Centre in Victoria in order to host our focus groups. At the Centre, we would have food available and would make a short presentation on what we were about to discuss. However, because teachers were too busy in general to make such a trip, and we did not want to wait until the sixth week of the project to collect these results, we elected to travel to two schools to conduct the focus groups there. The disadvantage of this was that we had to visit the teachers during their lunch breaks, and our discussion time was therefore limited to only twenty to thirty minutes. Fortunately, this did help us to motivate teachers to participate, because they did not have to take any time out of their actual workday to be a part of the focus group (although the teachers at the independent school did have to sacrifice part of their lunch break). The other two focus groups were conducted right at the CSIRO Science Education Centre, one with a government school that was already there for a science conference and another with the CSIRO educators. In these cases, we had the same

advantage of not taking up any extra travel time of the respondents because they were already at the Education Centre.

The focus groups were all recorded using a small tape recorder given to us by CSIRO Education, which we pre-tested to make sure it captured all of the discussion. In addition, a team member used a laptop computer to record important notes about the conversation as it happened. After each focus group, we listened to the audio recording as many times as necessary to produce an official written transcript containing the entire dialogue of the meeting. The transcripts from each meeting can be found in Appendix D.

Data Processing of Focus Groups

Our analysis of the data gained through our focus groups involved a thorough discussion of the results among ourselves, during which we formulated conclusions about the nature of the feelings of Victorian teachers regarding the addition of electronic components to CSIRO Education programs. Before we discussed our results, we prepared the data for each group in such a way that it was the most helpful to us by first asking the moderator of each focus group to add comments about the mood and other intangible aspects of the meeting to the official transcript. Once we had all of the possible data assembled into a final version of the transcript, we used the “cut-and-sort” technique to produce a summary of the focus group. To do this, we determined which parts of the transcript were the most important and categorized each statement by the topic it addressed. The summary was then assembled as a document with each statement being a piece of the data under a specific category, rather than being in chronological order (Bickman & Rog, 1998, p. 516). The summaries we produced can be found in Appendix E. These summaries allowed us to

perform a content analysis on the results, in which we counted the number of times that certain concepts were raised in the discussion by the respondents.

3.1.3 Student Survey

The third step in our methodology was to survey the students of Victoria. We decided to do this because teachers want what is best for their students, and so student opinions were also valuable to examine in our research.

Participant Questionnaire

To assess these children's valuable opinions, we created a student survey. We decided that the questionnaire for this survey should be completely closed format, using a similar Likert scale to the one used for our teacher survey (see Section 3.1.1). After drafting a questionnaire for the students who had already participated in CSIRO Education programs, we submitted it to Mr. Krishna-Pillay, who then made changes as he saw fit. Once the questionnaire had been finalized, it was pre-tested on a group of year 12 students who found no corrections necessary. The survey was quick and easy to complete, which was exactly what we were looking for in order to get a high response rate.

After finalizing the questionnaire (Appendix F), we moved on to distributing it to students who had participated in CSIRO Education programs. We started by traveling to schools that were hosting CSIRO Education presentations and distributed questionnaires to students at these schools. With advice from Mr. Krishna-Pillay, we handpicked the schools in such a way that we obtained results from students from all types of schools and grade levels. We traveled with the CSIRO educators to 5 different schools ranging from year 5 to year 10, and at each school we distributed questionnaires to the students after the presentations were completed, provided that

there was enough time and the teachers allowed us to do so. By doing this we acquired student opinions and got the chance to hand out some more teacher questionnaires at these same schools. While at these schools, we were also able to carry out some direct observation of CSIRO Education programs (see Section 3.3). Finally, we were able to hand out questionnaires to 4 student groups who had traveled to the CSIRO Science Education Centre in Victoria to participate in in-house education programs. In total, our survey covered students from year 5 to year 12.

Non-Participant Questionnaire

In order to get a comparative viewpoint, our group also created a questionnaire for students who had not participated in CSIRO Education programs (See Appendix G). The process for creating this was similar to the other student questionnaire, and we even repeated some of the questions on both questionnaires. For our sample group, we examined CSIRO Education's database of schools that had not recently booked their education programs, and we chose 20 schools at random from this list. We then called those schools to see if we could send them our questionnaire for the students to fill out. Our phone protocol for calling these schools can be found in Appendix H. If the educator agreed that we could send him/her the questionnaire for distribution to a classroom of students, we then offered to mail, email, or fax them a copy of the questionnaire. Eight out of the ten educators who agreed to hand out the questionnaire thought that email would be the most convenient, and since the survey had only nine short questions it would not be a problem for them to just print out and distribute copies of it. We sent out the questionnaires to the other two educators who agreed to participate via standard mail. As with the teacher survey, follow up phone calls were needed in the end in order to ensure that the survey was completed.

3.2 Marketing Electronic Media to Victorian Teachers

Since the CSIRO Education staff wants to add value to their programs through our suggestions, we also had to be cognizant of the fact that the marketing of these new products would play a role in the success of our suggestions. When thinking about how CSIRO Education might want to market an electronic component to its education programs, we first needed to understand what the customers of CSIRO Education want from these programs. We discovered this information through our surveys and focus groups with the teachers of Victoria.

3.2.1 Marketing Section on Teacher Survey

The teacher survey assessed customer opinions of electronic education in general and also included a section of questions that pertained directly to the marketing of electronically delivered programs. This separate section focused on what aspects of electronic delivery would be most appealing to teachers and can be found in Section 3 of Appendix B.

The first four questions of this section determined how useful teachers would find electronically delivered follow-up or preparatory information for programs, and they also asked the respondents if this information would be better delivered as a CD-ROM or a website. Question five asked teachers how much they would like to have access to online streaming video of recorded CSIRO Education presentations. By determining the general level of desire for an electronic component to CSIRO Education programs among the company's customers and determining the preferred form of this component, these questions gathered useful marketing data for our project. The next question was one of the most important ones in the survey, for it asked the respondents how willing they would be to pay extra money for these added online services. Finally, our marketing section featured an open-ended question in

which teachers could suggest any other forms of electronic delivery they might find useful. All of these questions were quite helpful to us because they directly asked CSIRO Education's potential customers how they felt electronic media could benefit them.

Immediately following this section were questions that assessed customer satisfaction with extension education programs. There were separate sections for teachers who had not recently booked CSIRO Education programs and those who had booked CSIRO Education programs before. The section for teachers who had not yet booked programs with CSIRO Education featured questions about whether electronically delivered components could make extension education programs such as the ones offered by CSIRO Education more appealing to them. The section for teachers who had already booked with CSIRO Education questioned the teachers about their level of satisfaction with the program, and it also asked them if they would find electronically delivered supplemental materials helpful. These sections are located just below the marketing section of our questionnaire.

This portion of the survey was pre-tested along with the rest of the questions with a few local educators. For more information on our pre-testing and how we assured respondent confidentiality, please see Section 3.1.1.

3.2.2 Focus Groups with Teachers

The focus groups that were conducted to determine teachers' desires for an electronically delivered component to education programs were also an essential vehicle for understanding how to market these features of the programs. Since a main function of marketing is tailoring a product to the needs of the consumer, focus groups are particularly well suited to market research (Bickman & Rog, 1998, p. 506). Our focus groups helped us to understand the best ways to market electronic

components by not only asking questions about what is desirable in an electronic program, but also asking questions that helped us to determine the value attached to this component in teachers' minds. This information allowed us to give CSIRO Education suggestions as to the product characteristics, the price of the product, and how to promote the product of an electronic component to the organization's education programs.

3.2.3 Student Surveys

Our student surveys also helped to determine how best to market electronically delivered components. Since a product that is unappealing to students would not be very helpful to teachers, it was important that we discover these users' opinions on how electronic delivery could add to CSIRO Education programs. For a longer description of our student surveying method, please see Section 3.1.3, "Student Survey."

3.2.4 Contacting Vendors of Electronic Media

The level and costs of electronic media vary in different countries. To get an accurate portrayal of the situation in Victoria, we needed to find out information regarding available electronic media and the costs associated with these media. We decided to contact the companies that sell electronic media systems in Victoria. We started by searching all of our available resources, including the managers at CSIRO Education, the Internet, and the Department of Human Services of Victoria, which has the largest IT department in Australia (Kerry Dineen, personal communication, March 20, 2004). From these, we obtained four names of people who could give us an idea of the costs and effort required to incorporate various forms of electronic media into CSIRO Education programs, including basic websites, CD-ROMS, and interactive

websites. We called all of these people and successfully set up appointments for interviews with two of them. The transcripts for these interviews can be found in Appendix I. The interviews investigated what forms of electronic media are available in Victoria and what the costs are of implementing each of these forms of delivery in a CSIRO Education program.

3.3 Integrating Electronic Media into Current CSIRO

Education Programs

Our primary goals for the project were to determine the best form of electronic delivery for CSIRO Education of Victoria to use to add value to their programs, and then propose how this electronic component could be marketed and implemented. Before we could propose a method to do this, we had to learn exactly what CSIRO Education programs were all about. Therefore, when we visited the schools to conduct our student survey (see Section 3.1.3), we made sure to directly observe and take notes (Appendix L) on each CSIRO Education program that was taking place. Since each of us visited different programs, as a group we gained an excellent idea of how a typical CSIRO Education presentation is carried out. This knowledge of CSIRO Education's existing programs helped us to realize what would work for CSIRO Education and what we should not recommend. For example, after observing only a few programs, we learned that it would not be worthwhile to deliver electronically materials for the demonstration or hands-on activity portions of a program because they require children's full attention, which is easier to get with an instructor talking to them. Also, in order to ensure that all children who participate in the program have a computer to use, the CSIRO Education presenters would have to carry several laptops with them every time they presented a program, which would be

too costly and time-consuming to have any worth (Simon Matheson, personal communication, April 16, 2004).

After analyzing the results of our surveys and focus groups, we thoroughly discussed these results with Mr. Krishna-Pillay and other CSIRO Education staff. After methodically evaluating each form of electronic delivery, we were able to come up with suggestions for CSIRO Education of Victoria to employ these methods. Once we produced our general recommendations, we planned to apply them by developing a prototype electronic supplement for one of CSIRO Education's current programs.

4 Results

Our research yielded several results that will help CSIRO Education add value to its programs through the use of electronic media.

4.1 Determining Which Electronic Media are Available

One of our main research objectives was to determine which forms of electronic media are available to deliver educational materials. This very broad research topic involved a thorough investigation of many different forms of electronic media and how they have been used in the past or are currently being used for education programs. The results of our search are discussed in detail in our Literature Review (Section 2).

Methods such as e-mail and simple, text-based websites are convenient, inexpensive ways of getting information to people. CSIRO Education could easily use these electronic media to distribute learning materials both to teachers and to students. However, our research suggests that many Victorian teachers feel that these electronic media may be too simple to add value to CSIRO Education programs (see Section 4.2). Media at the other end of the spectrum include Intelligent Tutoring Systems (ITS), which are electronic media designed to be so effective that they can almost replace a teacher altogether (Dr. Neil Heffernan, personal communication, February 20, 2004). Considering that such systems can cost over a million dollars and that they are designed to completely replace instructors, ITS systems would be of limited use to CSIRO Education.

Media such as CD-ROMs and interactive websites are intermediate in terms of cost and complexity. Both can be used to deliver text as well as interactive, graphical computer programs and video recordings. In addition, there are many past instances

where websites have been successfully used to implement entire multimedia educational programs. CD-ROMs have the advantage of being able to be used on any computer with enough processing power, while websites can reach any computer that is connected to the Internet. These two forms of electronic media are potentially successful ways of delivering CSIRO Education program materials electronically.

4.2 Determining Teachers' Opinions of Electronic Media

Our second objective was to determine the opinions of Victorian teachers on the potential use of electronic media in CSIRO Education programs. We conducted a teacher survey, four focus groups, and two student surveys in order to achieve this goal.

4.2.1 Results of Teacher Survey Distribution

After conducting the teacher survey as described in Section 3.1.1, we received 103 questionnaires back. These included 88 in direct response to our survey, and 15 questionnaires from teachers with whom we had direct contact while observing CSIRO Education presentations. Of these results, 49 questionnaires were from teachers who have not participated in CSIRO Education programs within the last five years, and 54 questionnaires were from teachers who have participated in the programs within the last year. This spread closely resembled our original population sample of half participant teachers and half non-participant teachers. We received 58 responses from Government Schools, 19 responses from Catholic Schools and 26 responses from Independent Schools. These results closely mirror the relative percentages of the different school types in the overall population of Victorian schools (See Table 4.1).

Table 4.1: Comparison of Distribution of Sample Population and Number of Survey Respondents (by School Type)

	Total Surveyed	Responses
Government %	166 51%	58 56%
Catholic %	65 20%	19 19%
Independent %	92 28%	26 25%
Total %	323 100%	103 32%

This corroboration between the distribution of data we received and the distribution of the surveyed population allowed us to draw conclusions from our data about the three different types of schools in Melbourne (Government, Catholic, and Independent) as well as about the differences between those teachers who have participated in CSIRO Education programs and those who have not. This was important when advising which electronic media option would best suit CSIRO Education because it allowed us to be more confident that our conclusions reflect all school types in Victoria.

4.2.2 Analyzing the Desires of Teachers

In the first section of our questionnaire, we questioned Victorian teachers as to what type of supplemental educational material they would like to see CSIRO Education provide. Electronic delivery of such material is not essential. However, each type of material we included in our questionnaire is well suited for delivery through electronic media. The full questionnaire can be found in Appendix B.

Victorian teachers generally rated these educational materials positively. The materials presented to the teachers in the first section of the questionnaire all relate to the question “Do you feel the following items would make CSIRO’s programs more

appealing?” Specific results for each question on the questionnaire are located in Appendix J. Each educational material presented received a rating of 4 or 5 (meaning “Most likely” and “Certainly yes,” respectively) from at least two thirds of the teachers surveyed. This seems to indicate that the use of electronic media would benefit CSIRO Education programs, because it would be a convenient way of delivering the materials that Victorian teachers want.

Lessons to be used after CSIRO Education presentations were rated particularly highly, as illustrated in Figure 4.1.

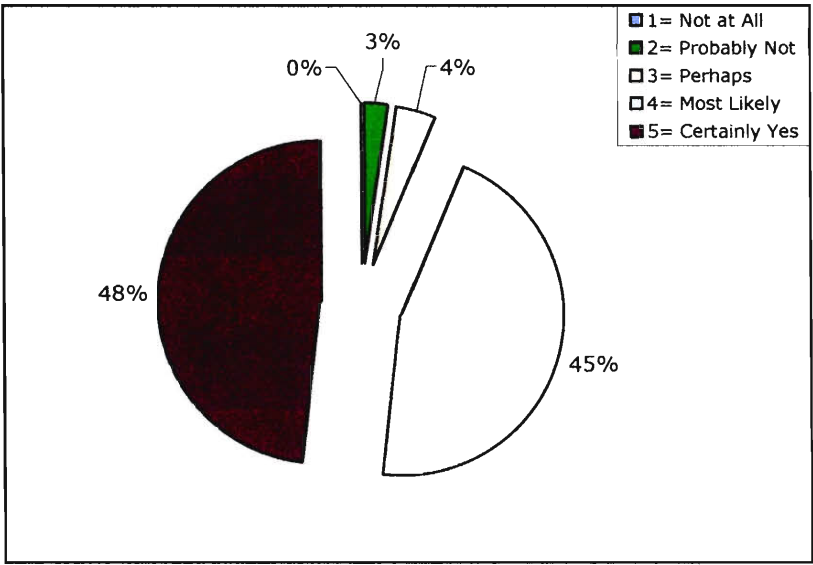


Figure 4.1: Results of Question 5: Desire for supplementary lessons to be used after CSIRO Education demonstrations by teachers.

Follow-up lessons for use after the demonstration portion of CSIRO Education programs received the highest percentage of positive ratings of 4 or 5 (93%). Only 3% of teachers surveyed rated this type of material as unappealing. This suggests that follow-up lessons for the teachers would supplement CSIRO Education programs especially well, and this type of educational material could certainly be delivered on a CD-ROM or website.

The one educational material presented in the first section that could only be delivered electronically was also rated highly, as shown in Figure 4.2.

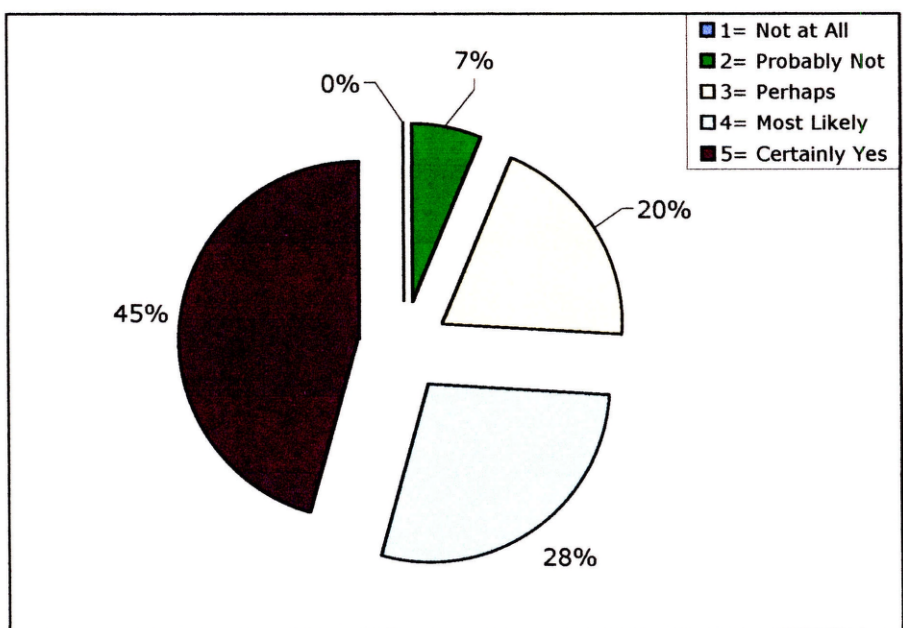


Figure 4.2: Desire for website to facilitate discussion among students on scientific topics

The teachers whom we surveyed generally thought that a website to facilitate discussion among students would be helpful. Seventy-three percent of the teachers surveyed answered with a 4 or 5, meaning that they thought this use of electronic media would be appealing when selecting an extension education program.

Interestingly enough, our research suggests that by itself, this particular use of electronic media might not be as helpful as these teachers believe. Many of the students we surveyed said they would not be interested in discussing material presented in CSIRO Education programs online (see Section 4.2.10 for more details).

4.2.3 Analyzing Teacher Media Rankings

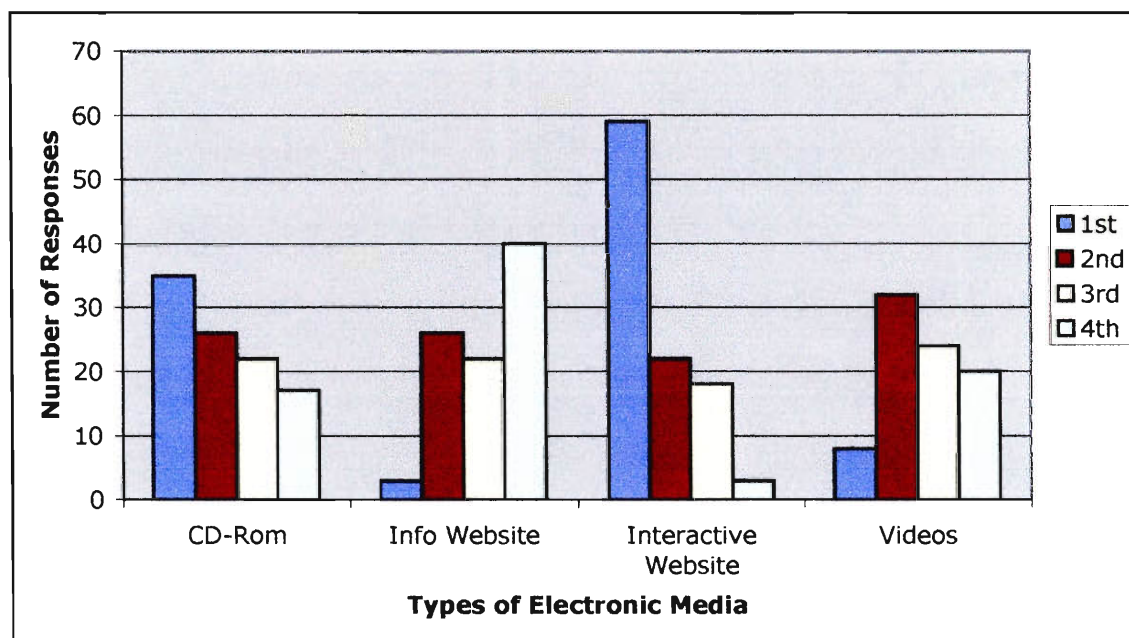


Figure 4.3: Results of Section 2: Rankings of usefulness of electronic media

This section of the teacher survey asked the teachers to rank CD-ROM's, text-based informational websites, websites with interactive elements such as discussion boards/online demonstrations, and videos of presentations for viewing on the Internet, in order of how useful they would find these products. Figure 4.3 shows the distribution of responses by how many teachers ranked each type 1st, 2nd, 3rd and 4th. The graph shows that an interactive website was the preferred electronic delivery medium, with almost 60 out of 103 teachers ranking it as their first choice. A CD-ROM was the second most preferred option, with 35 of the teachers ranking it as their 1st choice and 25 ranking it as their 2nd choice. The informational website was the least preferred, with fewer than 5 teachers ranking it first. This suggests that teachers would not find a strictly information-based website too helpful, a comment echoed in our focus group discussions (see Section 4.2.9). Although Internet videos did not receive many 1st place votes, they are still worth consideration because they received the most 2nd place votes. This suggests that videos may not be an option by

themselves but would be more effective when combined with another form of electronic media. For example, either a CD-ROM or a website could be used to deliver video clips, adding the value of video to the advantages possible with either of these media.

4.2.4 Analyzing Preferred Electronic Media Delivery Options

In the third section of our questionnaire, we examined which uses of electronic media with specific supplemental materials would be most appealing to Victorian teachers. We also asked about their willingness to pay for these additional services in order to gauge what kind of monetary value CSIRO Education could expect to place on these electronic deliveries.

Analyzing Electronic Media Deliveries

The first four questions in the third section of our questionnaire asked the respondents whether they thought preparatory or follow-up information for CSIRO Education programs would be useful for students or for teachers. While our respondents felt that all of these options had their merit, Figure 4.4 shows the information that the surveyed teachers felt would be most useful.

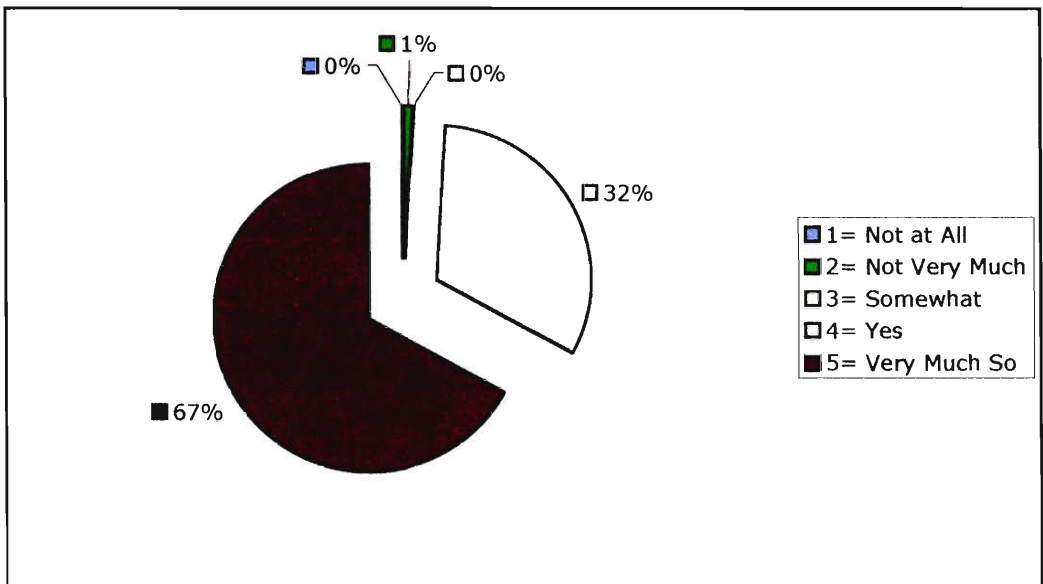


Figure 4.4: Desire for follow-up lessons/information to be electronically delivered to teachers after CSIRO Education program

The answers to this question are clear: 99% of teachers surveyed felt that follow-up materials and lessons for educators’ use would add value to CSIRO Education programs. The response was so positive that this question received the highest average score (4.65) on any of the questions common between participants and non-participants. In addition, as discussed below, most teachers felt that the best method for delivering such materials was to put them on a website. We conclude that having follow-up materials available on a website is the overall preferred method among teachers for incorporating electronic media into CSIRO Education programs.

Analyzing Results of Media Choice

Figure 4.5 below shows the teachers’ choices for each question in Section 3 of our questionnaire. These questions asked the teachers to choose between CD-ROM and website delivery of follow-up or preparatory information. In this figure, Question 1 asks teachers how useful they would find preparatory information for students, Question 2 asks them about preparatory information for teachers, Question 3 asks about follow-up information for students, and Question 4 asks about follow-up materials for students.

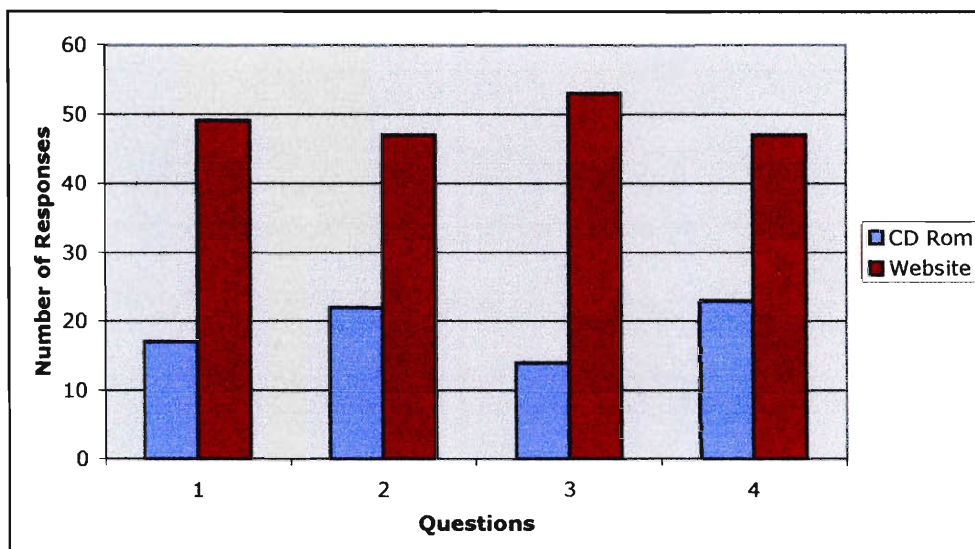


Figure 4.5: Teachers’ preferred electronic media for delivery of supplementary program materials

In each question, the number of respondents (listed on the vertical axis) who chose a website is clearly higher than the number who picked a CD-ROM. The results for questions 1 and 3 and those for questions 2 and 4 are almost identical, showing a widespread preference for Internet delivery of program materials. However, a substantial number of teachers selected CD-ROMs as their preferred method of delivery. As we discovered in a focus group, this is probably because some teachers feel that school Internet connections are not dependable enough to use for providing educational materials. Interestingly, a number of teachers selected both forms of delivery, indicating that it did not matter to them which form of delivery was used.

In the open response question at the bottom of the section, which asks, “What other types of delivery would be helpful?” teachers were given the opportunity to provide a few other suggestions for electronic media delivery. These suggestions included videos presented in some form other than the Internet, hard copy materials, and Black Line Masters (BLM’s), which are materials specifically made to copy easily. These results are intriguing, telling us that although most teachers would find

electronically delivered materials useful, there are several who still prefer having these same materials delivered in paper form.

4.2.5 CSIRO Education Participants vs. Non-Participants: Teachers

When stratifying our survey participants, we divided our overall sample population into two main groups: those teachers who have not participated in CSIRO Education programs and those who have. Those who have participated gave us specific feedback on how the programs can be improved and teachers who have not participated gave feedback on why they chose not to book CSIRO Education programs recently. In addition, the results gave us information on the differences in what teachers want in participating schools versus what teachers want in non-participating schools. In this section, we summarize the answers and discuss only those answers where these groups differed greatly from each other.

Comparison of Teachers' Needs

For the remainder of this section, the positive answers of the survey (an answer of 4 or 5) and the negative answers (an answer of 1 or 2) have been grouped together to improve clarity, with an answer of 3 being counted as a neutral response.

Table 4.2: Would CSIRO Education programs be more appealing if:

	Non-Participants			Participants		
	Positive	Neutral	Negative	Positive	Neutral	Negative
Students could reach topics more in depth	78%	20%	2%	73%	22%	5%
Students could repeatedly review info	65%	22%	12%	73%	16%	11%
Students could simulate demonstrations	92%	8%	0%	88%	8%	4%
Tests on the topic were available	76%	18%	6%	74%	16%	9%
Lesson plans on the topic were available	96%	4%	0%	89%	4%	7%

The answers for the first five questions were relatively similar, as shown in the above table. The results differed significantly for question 6, where there was definitely a more positive response from the participants compared to the non-participants (see Figure 4.6 below). This could mean that after seeing the student response to CSIRO Education programs, participant teachers thought that students would benefit from a web-based discussion.

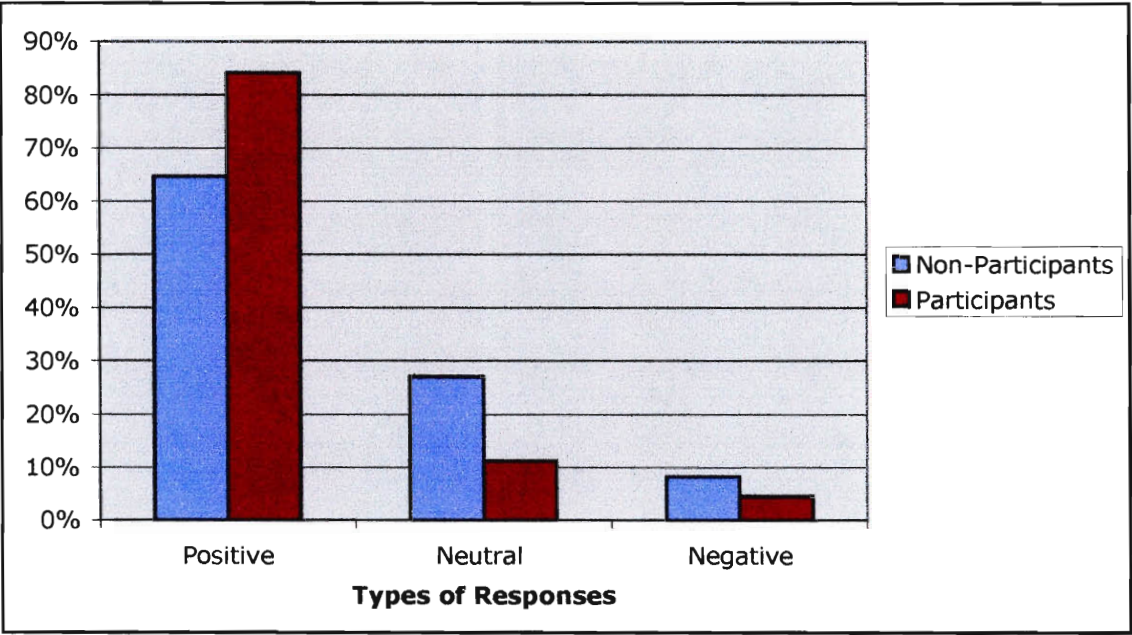


Figure 4.6: Appeal of Website to facilitate discussion among students on scientific topics

Comparison of Media Choices

In this section, teachers were asked to rank four types of electronic media in order of importance to them (1 being the most important, 4 the least important). The first type of electronic media is a CD-ROM. The results show a difference in opinion about CD-ROM between participant and non-participant teachers.

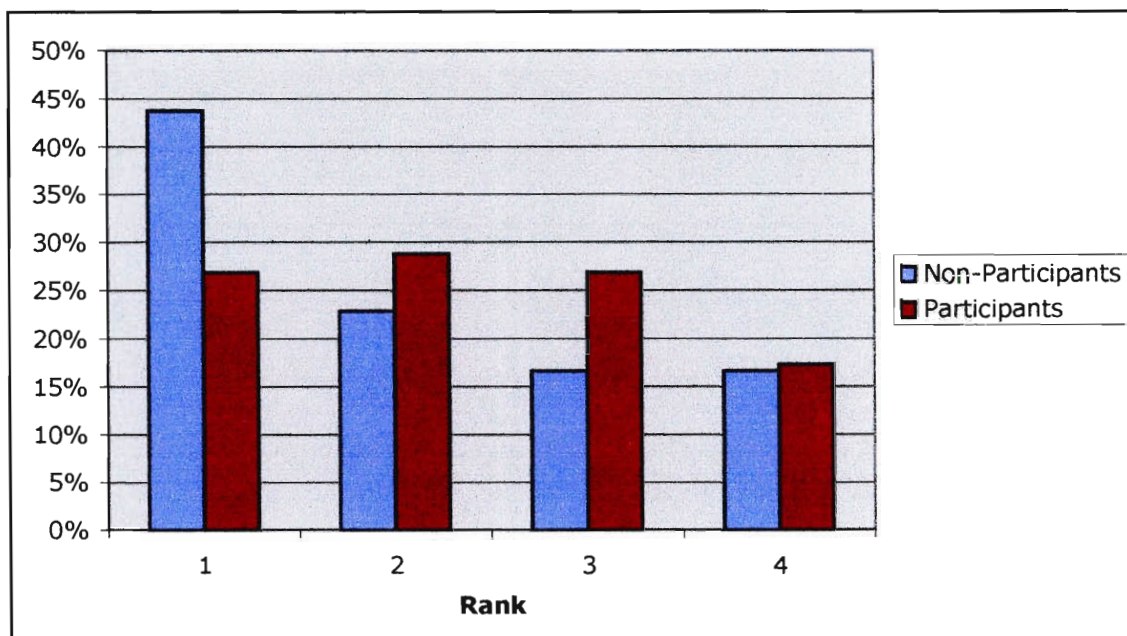


Figure 4.7: Ranking received by CD-ROM's

This graph clearly shows the preference for CD-ROM delivery among non-participant teachers, with almost 45% of them choosing CD-ROM's as their most valuable form of electronic media. For this question, the non-participant teachers chose CD-ROM's as their most important type of electronic media, while participant teachers chose CD-ROM's as their 2nd most important.

The next two graphs demonstrate the importance of websites to teachers who have participated in CSIRO Education programs recently. The first graph shows how teachers rank a website with information only.

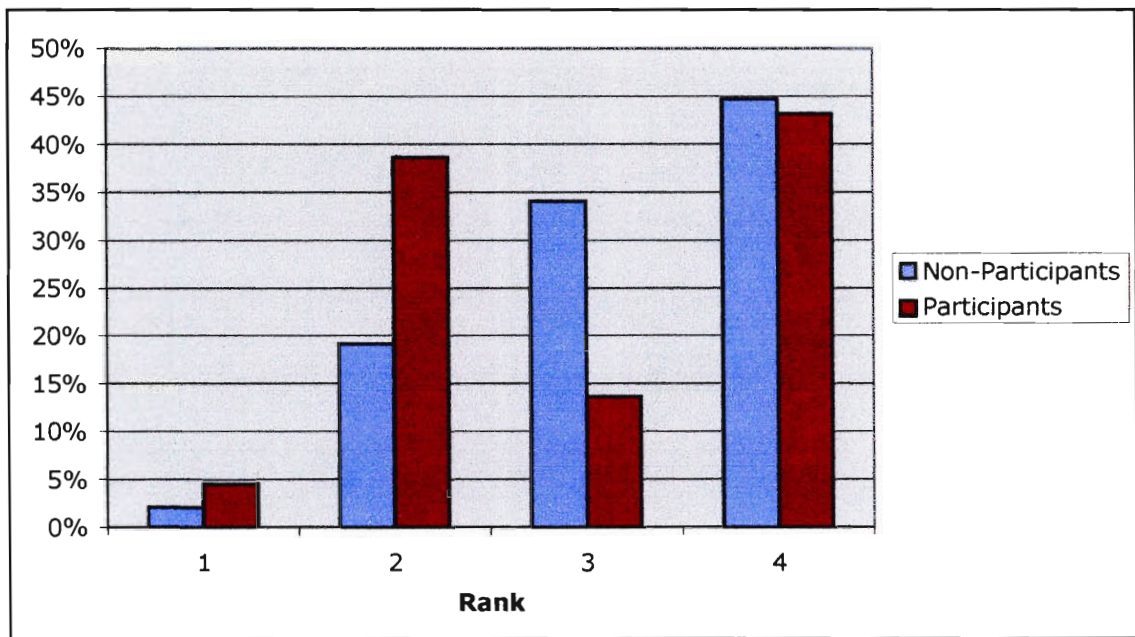


Figure 4.8: Ranking received by a website containing only information

Although most teachers (almost 45% from both groups) felt that an information-only website was the least important form of electronic media, the results do show that participant teachers think it is more important than non-participant teachers.

The next graph shows how the teachers rank the importance of an interactive website.

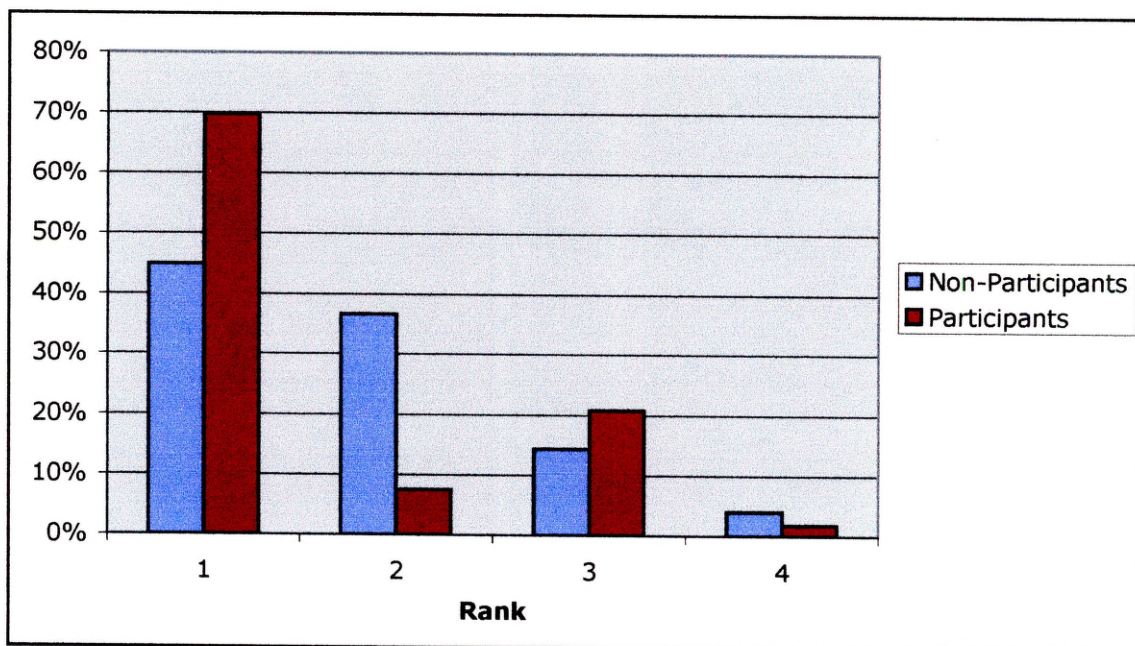


Figure 4.9: Ranking received by a website with interactive elements

Websites with interactive elements ranked highest for most teachers.

However, participant teachers seemed more likely to place this type of website as the most important. Although non-participant teachers also ranked interactive websites high, Figure 4.9 shows a large difference (25% of all respondents) between non-participant teachers, who were almost evenly split between CD-ROM's and interactive websites, and participant teachers, who overwhelmingly favored interactive websites.

The following graph shows the rankings of videos of presentations delivered online.

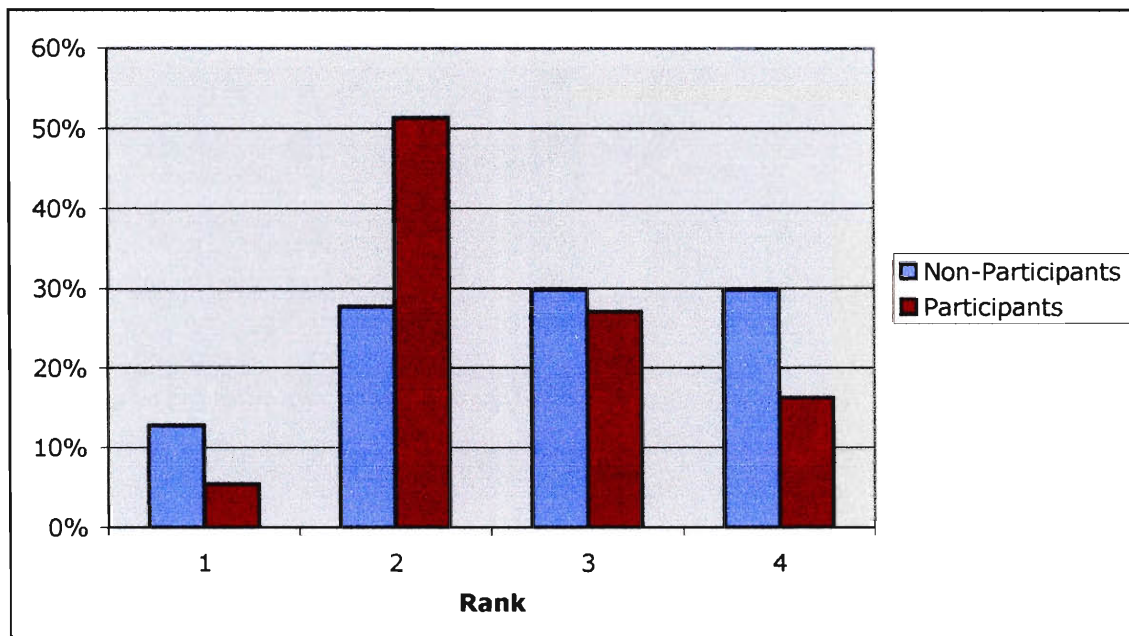


Figure 4.10: Ranking received by videos of presentations for viewing on the Internet

In this graph, we again see a disparity between the rankings of participant and non-participant teachers. About 50% of participant teachers said that videos online would be important to them, while the non-participants seemed divided on how important they actually were.

Comparison of Electronic Media Delivery Section

The next section analyzes the comparisons between participant and non-participant teachers with respect to what types of electronic media and what methods of delivery would be most appealing. For the remainder of this section, positive and negative answers will be grouped together in the same way as the section entitled “Comparison of Teachers’ Needs.”

Table 4.3: Appeal of potential CSIRO Education program additions to teachers:

	Non-Participants			Participants		
	Positive	Neutral	Negative	Positive	Neutral	Negative
Prep info for students	73%	19%	8%	67%	30%	2%
Prep info for teachers	92%	8%	0%	93%	5%	2%
Follow-up info for students	92%	8%	0%	88%	12%	0%
Follow-up info for teachers	97%	0%	3%	100%	0%	0%
Internet video of CSIRO's presentations	35%	39%	26%	49%	24%	27%
Willingness to pay extra	6%	37%	57%	12%	29%	59%

As seen in the above chart, the results for this section of the questionnaire do not differ markedly between participant and non-participant teachers. This suggests that participation in CSIRO Education programs had no bearing on the results of the questions in this section.

Comparing Electronic Media Choices

The results for both the participant and non-participant teachers are basically the same. Generally, teachers want a website over a CD-ROM in all of the circumstances outlined in the questionnaire. This is a valuable result because it shows that websites are currently the preferred type of electronic media to both participant and non-participant teachers in Victoria.

Analyzing Results of Non-Participating Teacher Section

To understand how to best market CSIRO Education programs, we asked teachers who had not participated in these programs in the last 5 years about what issues are important when deciding upon an extension education program. We also inquired about their feelings on how appealing electronic media are as additions to

programs. This was done in a special section of the questionnaire only for those teachers who have not participated in CSIRO Education programs (see Appendix B). In this section, teachers were asked to give their level of agreement with five statements dealing with issues that arise when choosing an extension education program.

The following two statements deal with two different types of media (CD-ROM and Websites) and which of these two would make education programs more appealing. These statements were designed to see if either CD-ROM or Websites were more appealing to non-participant teachers specifically. Our results for these questions can be found in Figure 4.11.

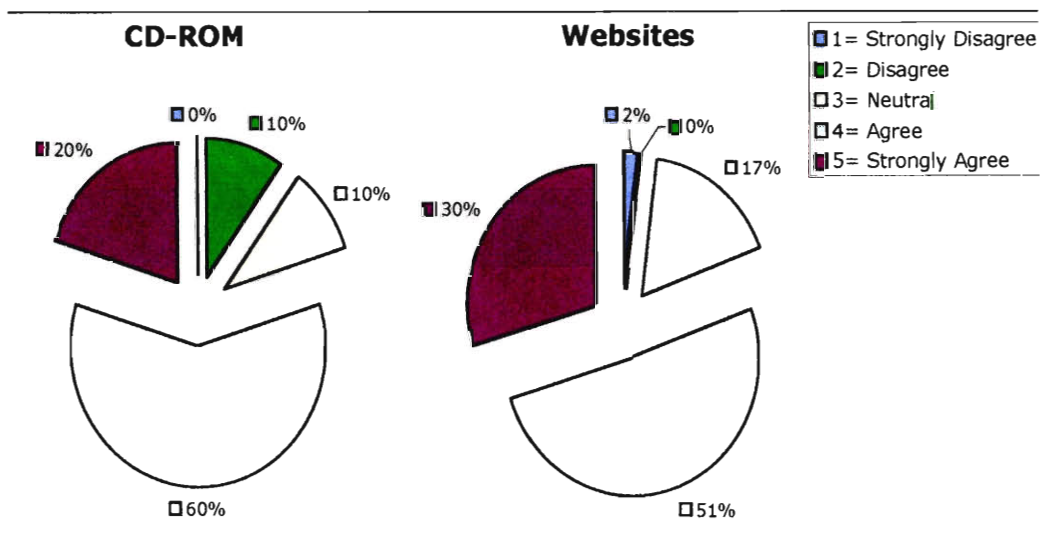


Figure 4.11: Agreement with the statement: “This medium would make programs more appealing”

Teachers felt that both these methods of electronic delivery make extension education programs more appealing. In the CD-ROM related statement (Statement 2), the majority of teachers (80%) agreed that this type of electronic media would be appealing. Ten percent of teachers disagreed that it would be helpful, which could mean that some teachers do not have access to adequate enough facilities to use CD-ROM’s with their students. In the statement of whether a website would be

appealing, an overwhelming majority (81%) of teachers agreed with the statement. Two percent of teachers strongly disagreed with this statement, suggesting that, like the CD-ROM issue discussed above, these teachers might not have adequate facilities to allow students Internet access. Overall, non-participating teachers felt that these types of electronic media would be appealing and could help CSIRO Education gain more of these schools as customers.

Since follow-up and preparatory information will probably be one of the main ways to use electronic media in CSIRO Education programs, the statement investigating whether these materials would make programs more appealing is very important to our research. The results for this statement are summarized in Figure 4.12.

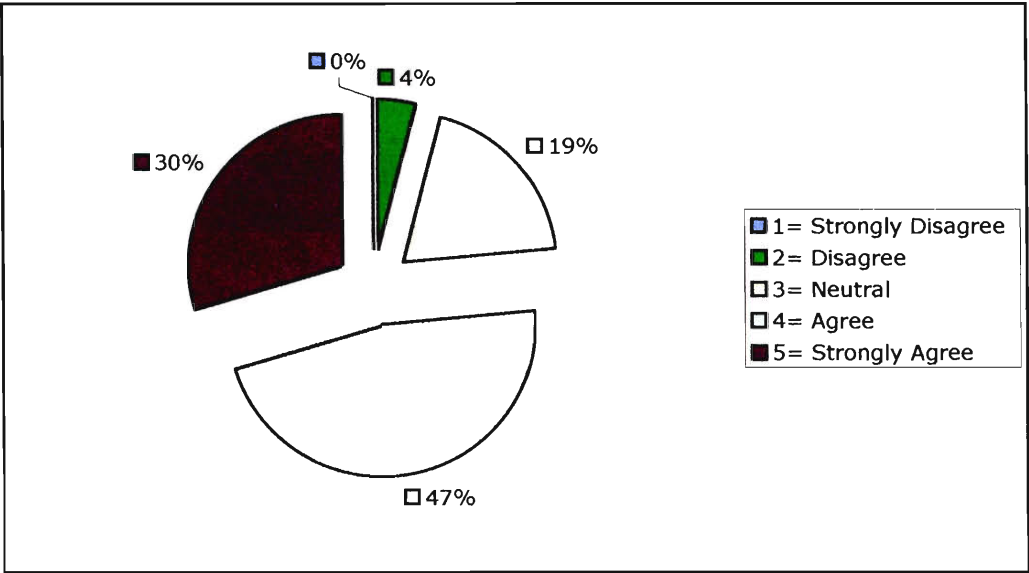


Figure 4.12: Agreement with the statement: “Follow-up materials have made programs more useful/appealing”

This graph shows the majority of teachers (77%) agree that follow-up materials make extension education programs appealing. Only four percent of teachers felt that follow-up materials were not useful or appealing. These results confirm our hypothesis that follow-up materials are important to teachers.

Analyzing Results of Participating Teachers Section

The graph below displays the results from the last section on the teacher questionnaire. It compares the results between CD-ROM and website supplements for CSIRO Education programs.

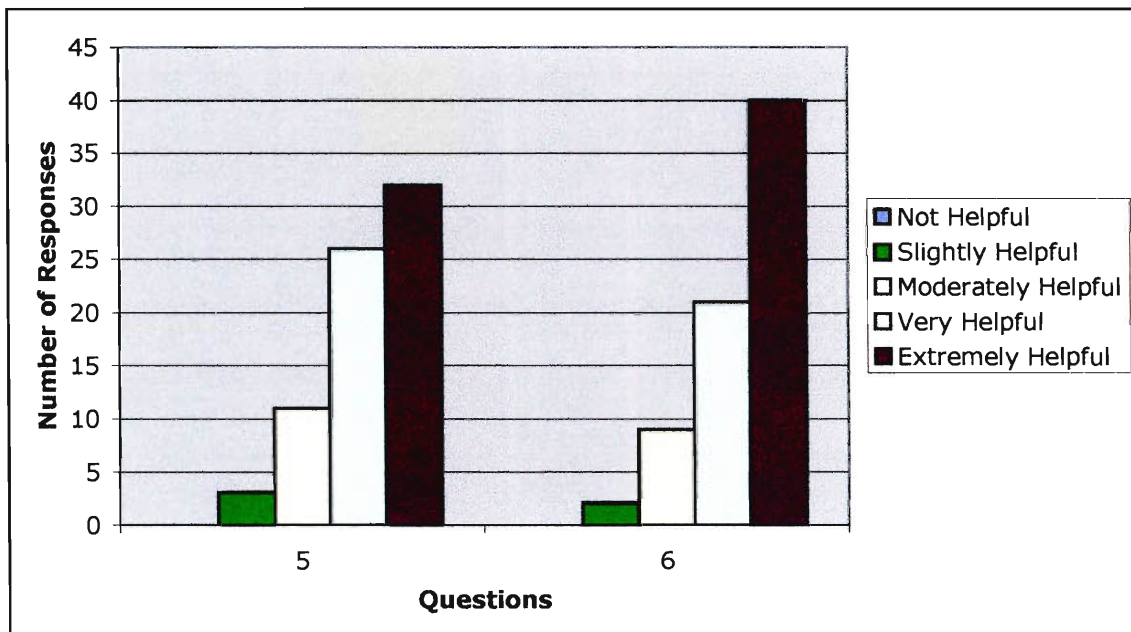


Figure 4.13: Question 5: Potential helpfulness of a CD-ROM in supplementing this program

Question 6: Potential helpfulness of a website in supplementing this program

In the last part of the questionnaire, teachers were asked to complete a section about programs that they have used before. The teachers' answers showed that they mainly used CSIRO Education programs to fulfill a curriculum requirement, not an assessment requirement. These data also showed that the teachers felt the programs could be more adequately followed up. Figure 4.13 shows that 80% of teachers answered positively when asked about following up the education program with a CD. 85% of the teachers answered positively to the question that asked about following up the education program with a website. Figure 4.13 also shows that 2/3 of the positive responses for the website came from the "Extremely Helpful" as opposed

to the “Very Helpful” option. This may suggest that teachers might find a website to be more helpful than a CD when following up the education programs.

4.2.6 Comparing Results of Different School Types

When examining the opinions of teachers from the three different school types (Government, Independent, Catholic), we found that there were not a lot of differences. However, we did note that that the Catholic school teachers ranked videos last when asked to rank different types of electronic media. This differs from the overall population where strictly informative websites were ranked last. The rest of the sections dealing with the teachers’ questionnaire for each school type were primarily the same and can be found in Appendix J.

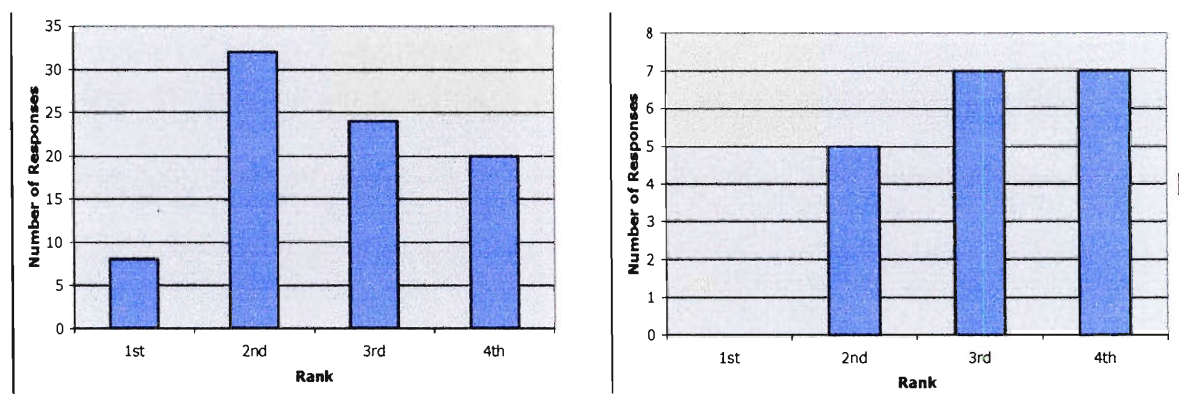


Figure 4.14: Overall ranking of Internet videos (left).

Catholic teachers' ranking of Internet videos (right).

Figure 4.14 above represents how teachers ranked videos against interactive websites, CD-ROM’s, and informative websites. The graphs only show the number of 1st 2nd 3rd and 4th place votes that videos received.

4.2.7 Comparing Results Based on School Income

According to Rebecca Carter, Independent schools are generally wealthier than Government schools (Rebecca Carter, personal communication, April 16, 2004). This section analyzes the results from the student survey in two schools: a “wealthy”

Independent school and a “low-income” Government school. This section is meant to be a snapshot of a larger picture and does not generalize for all wealthy and low-income schools.

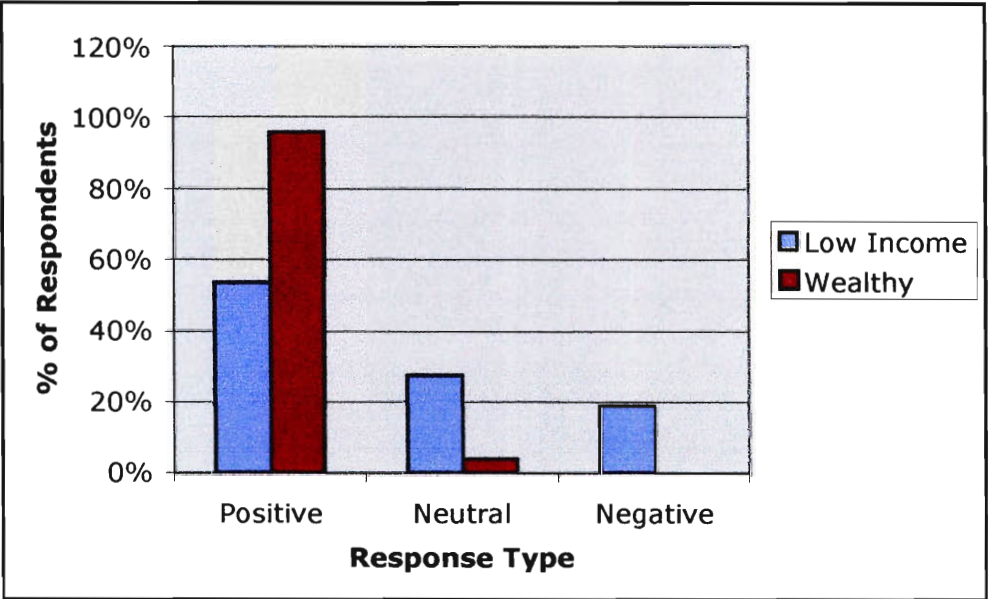


Figure 4.15: Do you go online often at school?

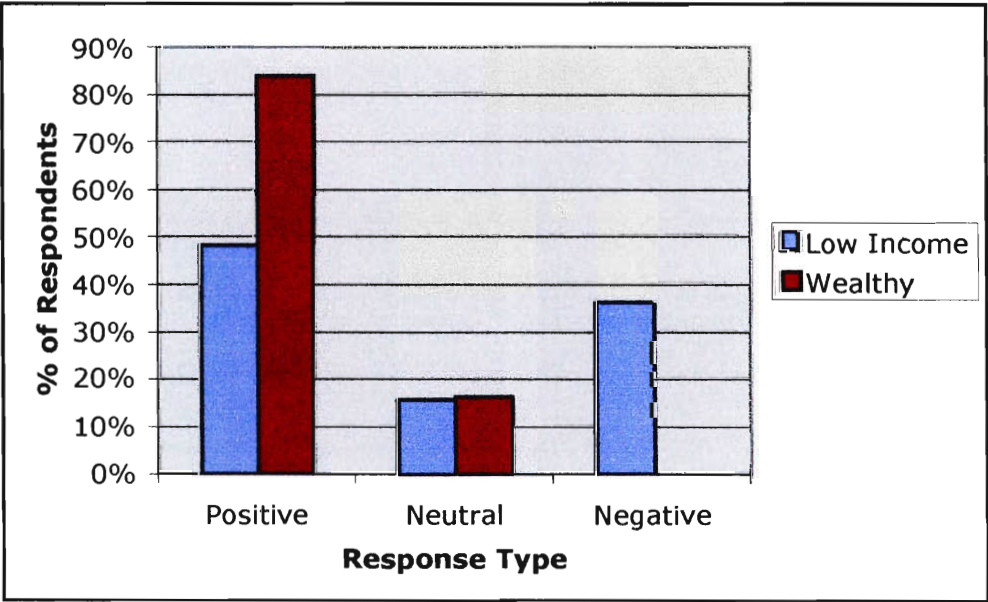


Figure 4.16: Do you go online often at home?

The two graphs in Figures 4.15 and 4.16 suggest that students who attend low-income schools have less Internet access compared to students from wealthier schools. These figures suggest that in both cases, whether at home or at school, the

low-income students have a considerable disadvantage when it comes to availability of the Internet. Over 90% of the students surveyed from the wealthier school answered positively to using the Internet often at school, as opposed to less than 60% of the students from the lower-income school. Similarly, over 80% of the students from the wealthier schools go online often at home while less than 50% of the low-income students do. Since the access levels of students differ, teachers in wealthier schools would be more likely to find electronic media appealing.

4.2.8 Teacher Comments

At the end of the teacher survey, the respondents were asked to add any comments they might have had about how electronic media could add value to CSIRO Education programs. One teacher's comment was, "Website access would be beneficial as follow up activities and for added information." Another teacher wrote, "Most of this is relevant on schools having good computer/internet access and we find at our school due to maintenance, costs, etc., this is very unreliable." These comments, each of which was echoed several times by other respondents, summarize how many teachers in our study felt about electronic media. These teachers' comments show that they generally felt that supplementing CSIRO Education's programs using electronic media would be helpful, but they do not all have easy access to computers and the Internet at their schools.

Some of the teachers commented on topics related to the students. One teacher's comment related to blended learning, saying, "CD ROMs and websites would be good - but only as a supplement to current presentations as you still have teachers who do not make good use of computer resources." This further supports focus group comments (see Section 4.2.9) that some teachers would desire electronic supplements but only in addition to live presentations so that the students can get the

most out of the experience. Another teacher thought that an interactive website would be great for students because then they could go back and revisit the activity and learn the theory behind it. Overall, the comments on the returned questionnaires confirm the survey results and show how teachers desire the option that will be the most valuable in terms of learning and cost for educating their students.

4.2.9 Focus Groups

A total of four focus groups were conducted with educators from the greater Melbourne area. These focus groups assessed the respondents' opinions on the advantages and disadvantages of electronic media and their possible uses with CSIRO Education Programs.

Advantages/Disadvantages of Electronic Media

We asked the participants in each focus group about the advantages and disadvantages of using electronic media in education programs. In addition to the educators' responses to this particular question, they also discussed items relating to these advantages and disadvantages throughout the focus group conversations.

The most common advantage mentioned was the potential for the use of electronic media to increase students' motivation to learn. During our four focus groups, this idea came up six times in total. The respondents gave several reasons as to why they felt this way. Multiple respondents said that when material was presented to their students on a computer, the children definitely seemed more engaged. One teacher suggested that since learning through electronic media is a different learning style than children are accustomed to, the change of pace might serve to motivate them. Multiple respondents stated that electronic media certainly have their advantages, provided that the computer programs utilized are easy for the students to

use. The focus groups suggested that the added enthusiasm that students can gain from electronic education programs is a main focus of teachers' interest in these programs.

Another commonly mentioned advantage was that an electronically delivered program component could easily be made interactive. This topic came up four times during the focus groups, and all of the educators present in our first two focus groups agreed that the interactive aspect of the program was important. In fact, several educators said that students need to be able to manipulate the program or change variables in some way in order for it to be of any real use to them, with one respondent stating that a website or program containing only words would be no better than a regular book. As one teacher stated, educators would be willing to pay extra for the added value of electronically delivered materials, as long as the materials were sophisticated and relevant enough to justify the cost.

The educators also mentioned that they thought that using electronic media in education programs was useful as a means of keeping children accustomed to using computers and technology. According to one respondent, learning electronically is preparation for the increasingly technological world that we live in and is therefore necessary. Teachers should therefore readily incorporate the use of electronic media into their education programs.

In addition to the advantages discussed, some potential disadvantages also came up in the conversations. One teacher who had used online quizzes with his students had a bad experience, saying that it was too easy for the children to cheat. He said that his students would read material online, and as they were taking the online quiz for that material, they would simply open the Web page containing the reading material, even though they were not supposed to do so. This suggests that elements such as online assessments may not be suitable for a program that is meant to test

students' knowledge by grading them on it unless considerable adjustments are made to the computer program to prevent students from cheating.

Another potential disadvantage discussed was that many teachers believe that teaching with electronic media alone is not very effective. A respondent in one of the focus groups said that it must always be used in conjunction with more traditional forms of teaching. Another teacher suggested that children should always be required to present their knowledge verbally to prove that they truly understand the concepts that have been taught. These concerns of the respondents reflect what was discovered in our background research for this project, which is that electronic education is at its best when combined with live instruction from a teacher in a blended learning environment. Since CSIRO Education's electronic components will be used to *supplement* the live demonstration portion of the program, these concerns will be addressed.

Delivery Methods

Because of time constraints for each focus group, our discussions on different delivery methods focused primarily on CD-ROMs and websites, because these are the two most common and well-known electronic media. We chose to use our time to discuss these media rather than others such as e-mail or television because e-mail cannot be used effectively to deliver large, complex files, and if a television is used to deliver program materials, it is difficult to make them interactive. With a CD-ROM or website, both interactive elements such as computer programs and non-interactive elements such as recorded videos can be delivered to the user effectively.

CD-ROMs were mentioned ten times as a viable form of electronic delivery. As one respondent noted, their large storage space allows a very broad range of information about any given topic to be carried. Therefore, as long as the CD program

was well developed, it would be useful to teachers in that it would give them more information to use in their lessons. Another advantage to the large storage space of a CD-ROM is that it can be used to store large videos that can then be easily accessed on a computer. As one respondent suggested, these videos could be recordings of demonstrations that are too dangerous to perform live, such as the chemical reactions of certain volatile elements in the periodic table. Interestingly enough, on three out of the ten occasions in which CD-ROMs were brought up as an excellent form of electronic delivery, another teacher immediately mentioned that a website could do the job better.

There were twenty-seven different comments made during our focus groups on the great potential of websites in electronic education programs. One of the main advantages of a website is that the information on it can be updated regularly, and any background information supplementing an extension education program could be guaranteed to be as new as possible, provided that the staff has enough time to keep it updated. In fact, during our focus group at Camberwell Grammar School, every teacher in the room felt that a website would be more useful than a CD-ROM because it can be more easily updated. One respondent thought that it would be great if students got the chance to develop their own websites, and much of the instruction for doing this could be delivered online. A website also has the advantage of flexibility, because there is no need for distributing hard copies of the material, as is necessary when utilizing CD-ROMs. One respondent suggested that teachers could pay money and receive a logon name and password that would give them access to an informational website for a year. Such a website could extend the CSIRO Education demonstration by providing research projects that fit into the school curriculum for the students to complete, and it could provide support material and topic plans for the teachers. The enthusiasm with which our respondents discussed the use of websites in

extension education programs suggests that online delivery of educational materials is an excellent approach.

Potential Applications

Several different potential applications of electronic media in education came up during our discussions. Several of these ideas were discussed multiple times, suggesting that they may be common to many Victorian teachers.

The most popular concept discussed was that of electronically providing background information for extension education demonstrations. This idea was brought up on sixteen different occasions during our focus groups. Each time, the respondents stressed that this background information could really help them drive home the core concepts covered in an extension education program. Follow-up materials for use after the extension education program would be particularly useful, allowing teachers to seamlessly integrate concepts presented in the demonstration into their teaching material. One teacher went into more detail, saying that many science teachers could use background information on specialized topics such as geology or astronomy, because they have had no real prior education in these fields. Background information can therefore be very crucial in order to allow teachers to completely fulfill their students' desire to learn more about an exciting topic.

On three instances, the topic of online assessments came up in our discussions. A website would be a convenient, easy way of administering a quiz or otherwise testing students' knowledge of a subject. One teacher felt that not only could objective quizzes be taken online, but also older students could submit drafts of papers online and get the quickest possible feedback from their teacher.

Several other applications of electronic media were brought up in our discussions. According to one respondent, by recording extension education

demonstrations and making them available as a video over the Internet, CSIRO Education can reach out to customers in rural areas where it would be very hard to send a presenter, provided that these customers have reasonably good Internet access. A website could also be used to present animations that simplify complex processes so that students can more easily understand them. Finally, one teacher said that a website is a great way to present educational exercises that are trial-and-error in nature and would therefore use up resources such as paper or chemicals if they were performed traditionally.

4.2.10 Student Surveys

Successful CSIRO Education programs require an initial interest from the students. Our survey had 9 questions dealing with the students' opinions on certain topics. The student survey gives information about the second objective in our project, which was to determine what the teachers think about electronic media. Since teachers value their students' opinions, we surveyed students to find out what they think about technology.

Distributing the student surveys, as outlined in Section 3.1.3, resulted in 351 total valid responses. We collected 310 questionnaires from the students who have participated in CSIRO Education programs by traveling to schools with the presenters and handing out and collecting questionnaires from the students. We obtained 41 non-participant student questionnaires by receiving mail from 2 out of 7 teachers of non-participant schools who told us that they would have a class of students fill out the questionnaire.

Participant vs. Non-participant Student Results

Figure 4.17 below represents the percentage of students (on the left is non-participant students, on the right is participant students) that desire to discuss science with other students online.

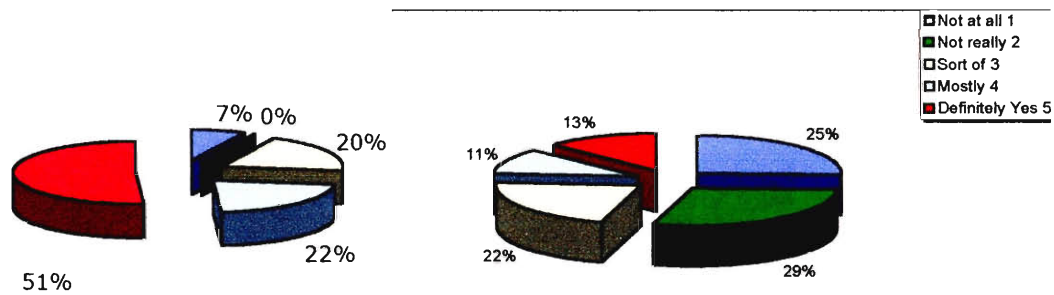


Figure 4.17: Appeal to students of online discussions

In both questionnaires, the first 5 questions were the same. These questions dealt with the students’ general opinions about computers and the Internet. For both participant and non-participant students, over 80% of them felt computers were easy to use. For both groups there were only a handful of students who answered negatively when asked if the Internet was easy to use. Over 80% of the participants felt that the Internet was easy for them to use along with 63% of the participants finding the Internet enjoyable. For the non-participants, only 53% of them found the Internet easy to use, but 90% of them thought that using the Internet was enjoyable. As shown in Figure 4.17, the participants were not interested in talking online about schoolwork but the non-participants were very interested, with 73% of them responding positively to the question on the questionnaire.

The statistics from the student survey are important to teachers when deciding whether to use electronic media in education. This information is helpful because it shows that participant students *and* non-participant students would not have struggle with using computers for supplementing education programs. This also shows us that although non-participants find it harder to use the Internet than participants, they also

find it more enjoyable. These data suggest that the participant students would find using the Internet easy and that although not all of the non-participants find it easy, almost all of them enjoy using it. This is important for the teachers because as discussed in the focus groups, the teachers like educational information to be easily incorporated into the classroom.

Figure 4.18 below represents the students' responses regarding where (home or school) and how often they go online. The graphs on the left show the responses for students that have participated in CSIRO Education programs and the graphs on the right are for students that have not.

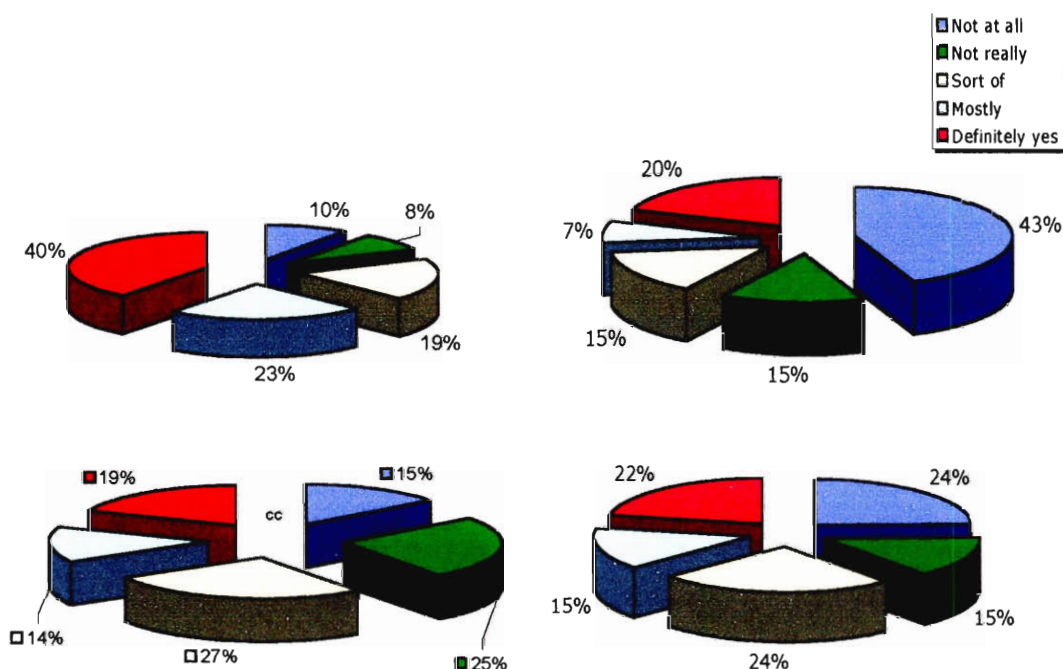


Figure 4.18: Top Left side: Participants –Do you go online often at home?

Bottom Left side: Participants – Do you go online often at school?

Top Right side: Non-participants –Do you go online often at home?

Bottom Right side: Non-participants – Do you go online often at school?

The results shown in Figure 4.18, which dealt with how often a student went online at home and at school, were another important part of the student survey. As shown in this graph, participant students go online more often at home than at school, with 63% of the participants answering positively to going online often at home and only 33% saying they go online often at school. With non-participants, 58% said that they do not go online often at home as opposed to 39% saying they do not go online often at school.

This is important because the type of electronic media preferred by teachers may be influenced by the availability of Internet access for the students. As one focus group discussed, it would be better for students if education programs were supplemented with a website, because the students would be able to access the

information at home. In the same focus group, another teacher said that a CD would be better because the Internet is always down at the school. This suggests that more than one form of electronic media would be useful for teachers to fit their students' needs.

4.3 Marketing CSIRO Education Programs to Victorian Teachers

The third objective of our project was to investigate what would be involved in marketing an electronically delivered addition to CSIRO Education programs. Because we did not have a specific product to evaluate in terms of marketing, we instead searched for general data on what customers would find useful in a potential product and the costs involved. We gathered useful marketing information through our teacher survey, our focus groups, and by interviewing local companies that sell electronic media.

4.3.1 Information from Teacher Survey

One of the main aspects of the “marketing mix” that must be considered by all firms is the qualities and attributes that customers would like to see in their products (Kasouf, personal communication, January 16, 2004). The form of electronic delivery that appeals most to teachers would therefore be the form that CSIRO Education should adopt to supplement its programs.

While the respondents to our teacher survey showed enthusiasm about several materials to be delivered electronically, they favored follow-up information and lessons as the most helpful additional material (see Section 4.2). To deliver this information, our respondents preferred an interactive website over other forms of electronic media. Our research suggests that the method of supplementing programs

that has the greatest chance of success for CSIRO Education is the use of a website to provide follow-up material for teachers to use with their students along with interactive programs to enhance the students’ learning experience.

The last question in the third section of the teacher questionnaire was of particular importance to our liaison because CSIRO Education is constantly looking for new sources of funding for its programs. The question asked teachers how willing they would be to pay for these extra services. Since no monetary figures were used in the question, it was intended to gauge a general feeling of willingness to pay extra. The responses to this question are summarized in Figure 4.19.

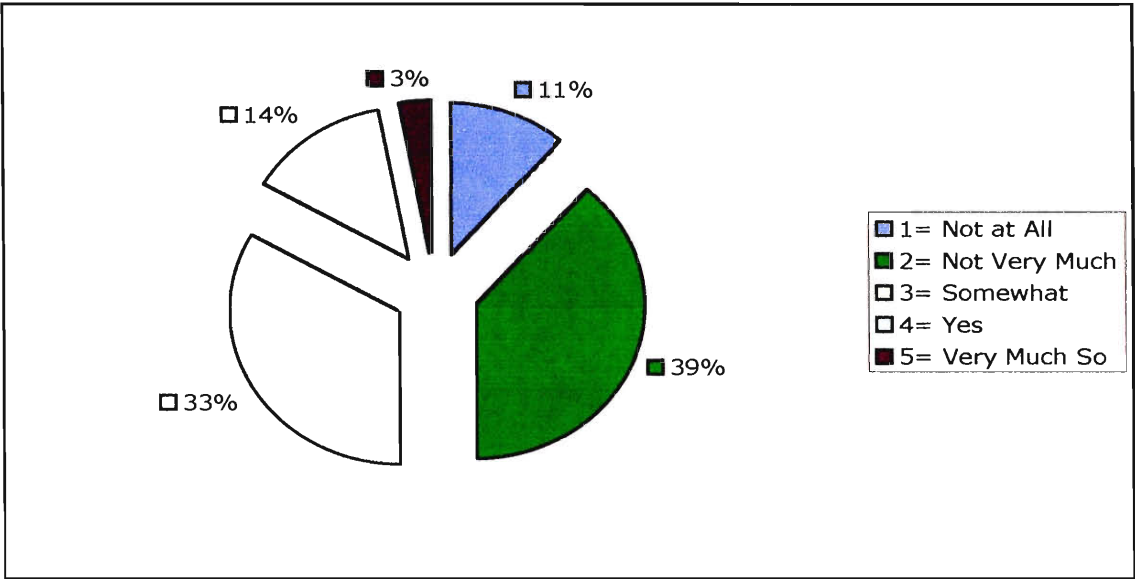


Figure 4.19: Willingness to pay extra for additional electronically delivered services

These results seem negative, but due to budget cuts and the many comments on the surveys stating that money was tight, the observation that there were people who were willing to pay indicates that there must be interest in having these extra services. Seventeen percent of respondents were definitely willing to pay extra, which suggests that they must value what these electronic media can do for them as

educators. In addition, the results would most likely have been more positive if we were able to provide the teachers with a specific electronically delivered service to evaluate.

4.3.2 Information from Focus Groups

Our discussions with local educators in our focus groups also revealed information that could be important when marketing new electronic additions to CSIRO Education programs. One teacher suggested the use of a logon name and password that teachers could pay for as a convenient way of distributing access to a website (see Section 4.2.9). This access could be sold to teachers, and would allow them and their students to access the many features that would be built into such a website. Another teacher suggested that with a logon-based website, there could be a free trial period during which teachers could evaluate the educational material on the site before financially committing to it. This could be used as a method to attract users to try CSIRO Education's electronic supplements for the first time, and from there the program content would have to be useful to retain these potential customers. Also, as one educator stated, if CSIRO Education chooses to utilize a CD-ROM, one marketing strategy could focus on CD-ROMs as concrete objects that teachers can hold in their hands. This psychological factor could influence teachers to buy programs on CD-ROM, because they will be purchasing something that they can physically keep track of and that does not rely on Internet connections, which may or may not be reliable. It is most important for CSIRO Education to keep in mind the comment by one of our focus group participants that no matter what form an electronically delivered program supplement may take, if teachers perceive that it will help significantly to do their job, they will be willing to spend a reasonable amount of

their teaching budget on it. By incorporating all of the features that teachers want into its electronic program components, CSIRO Education can maximize teacher interest.

Several potential disadvantages of electronic media from the perspective of CSIRO Education were brought up in our focus group with CSIRO Education Centre employees. These educators know that one of the best aspects of their programs is that they can explain relevant material in person, and they believe that using electronic media to deliver this material would actually detract from the value of the programs. They also believe that delivering preparatory information electronically would not be of much use because CSIRO Education programs are designed to be self-contained, and so the presenter of the program explains key concepts during the program with no need for them to have been previously taught. Finally, participants in this focus group cautioned against making too much material available on a website. If videos of CSIRO Education demonstrations were available online along with a large amount of information, it could undermine the company's business because teachers might be inclined to purchase only the electronic portion of CSIRO Education programs. As Simon Upchurch from CSIRO Education said, "Using the Internet is important, but we have to be careful" (Simon Upchurch, personal communication, April 16, 2004).

4.3.3 Contacting Vendors of Technology

CSIRO Education has many options for choosing an electronic media developer in the Melbourne area. We contacted local electronic media developers, and we found price ranges and the types of services that are available to CSIRO Education for developing our suggestions. The main area of focus when collecting our data was to find out what the approximate costs of developing a website or CD-ROM were. These two types of electronic media were singled out because they were most preferred by the teachers in our survey (See Section 4.2). In all of our results, the

price quotes are only approximate pending exact details of what the development would entail.

Websites

Our research has found two price scales for a website, each with its own features and benefits. The features involved in each electronic media system delineate these levels. As with most areas of development, the more features that exist in a product, the higher development expense. Development costs are lowered because CSIRO Education already has space to put the website on and has a host for its site. These services often make the price of developing and maintaining a website much higher.

Web Genius Development (www.webgenius.com.au), a Melbourne-based development company, deals with creating websites for local businesses. Robert Dark, an associate with the company, said that the base price for a website would be around AUD\$3,500-\$4,500, with complexities such as interaction with a database (i.e. allowing certain teachers to login and having administrators who can change/update the site), the ability to upload files and the addition of a bulletin board additional costs (Robert Dark, personal communication, April 19, 2004). Mr. Dark also noted that e-learning technologies on the website will also increase the price, with services such as online tests that are sent directly to the teachers being less expensive than online tests where student responses are tracked in a database. He noted that Flash animations would be the best way to show interactive demonstrations on the page since 98% of the market can read and use Flash technologies. Additionally, he stated that the costs of incorporating streaming media into a website are relatively low and that the main costs are producing and formatting the media so that they are ready for the Internet. This implementation of a website would be very basic and would require further

development by knowledgeable people when changing or updating the website in the future.

Create-it Technologies (www.createit.com.au), another Australian company, proposed a website containing a content-management system developed by an American company named Ektron (www.ektron.com). This system is an easily upgradeable, complete system that would encompass all the needs of CSIRO Education today and into the future. Chris Keenan from Create-it said that the estimated cost of the licensing of the Ektron system would be AUD\$9,500. Create-it Technologies would then develop the templates to be used with the system as well as the files that would define the way that different pages would look. The cost quoted for these set up services was AUD\$8,000. Included in this price is a year's worth of updates to the Ektron system and maintenance to the website.

Although these prices are much higher than the first company, the added cost comes with great benefit. This content management system would be an extremely simple way to maintain and update the proposed website because it would allow for a simple Microsoft Word-like interface to edit material. This interface is completely web-based and allows for easy uploading and posting of documents and other media such as videos or flash animations. Along with the ability to upload files, the system (beginning toward the end of 2004) will come with a bulletin board. The beauty of this system is that it takes almost no technical knowledge to edit and maintain, and the ease of use allows for the ability to frequently update the website.

The system also comes with a feature that allows for multiple people (10 users included with the price quoted above) to edit the page and sets up a chain of command structure that allows the manager to accept or reject any changes made to the document by other employees. Along with the ability to have users who can edit the website, the system allows for users to log in and see pages that other visitors to

the website would not be able to. This would allow CSIRO Education to give teachers login names to gain access to special web pages. These login names could be created to expire after a certain time period as well.

CD-ROM

The costs related to producing a CD-ROM to supplement CSIRO Education programs have gone down significantly. CD burners are found in most new home computers and the price of CD-ROM media is under \$1 for a single CD.

Development of interactive animations and programs would be the main costs related to this type of delivery, but since we hope for these programs to be produced for the website, a simple transfer to a CD-ROM would not add to the cost. We have found through our survey that the best way to utilize CD-ROM technology would be to put the proposed website (Section 4.2.2) in its entirety on a CD for schools who have inadequate Internet access. This would allow students and teachers in all schools regardless of facilities and economic standing to access this addition to CSIRO Education programs.

4.4 Integration of Electronic Media into CSIRO Education Programs

We examined the results of our surveys and focus groups to determine which educational materials and other elements should be included in an electronic supplement to one of CSIRO Education's programs. We combined these elements into a template for CSIRO Education to use in the future to ensure that electronic components to its programs contain all the features that Victorian teachers would like to see. In addition, we used our template to create a sample website for a CSIRO

Education program as an example of what a future program supplement might look like.

4.4.1 Templates for Incorporating Electronic Media

Our surveys and focus groups suggested that there are certain features that Victorian teachers would like to see in electronically delivered CSIRO Education program supplements. We produced a template for incorporating electronically delivered extra information for teachers and another template for adding supplementary educational material for students, both of which included the features that we found would be useful to Victorian teachers. By incorporating all of these items, CSIRO Education could produce electronic components to its programs that would appeal most to its customers and would therefore be the most marketable.

Teacher Template

The template shown in Figure 4.20 contains all of the features that we believe should be incorporated into a website for teacher use.

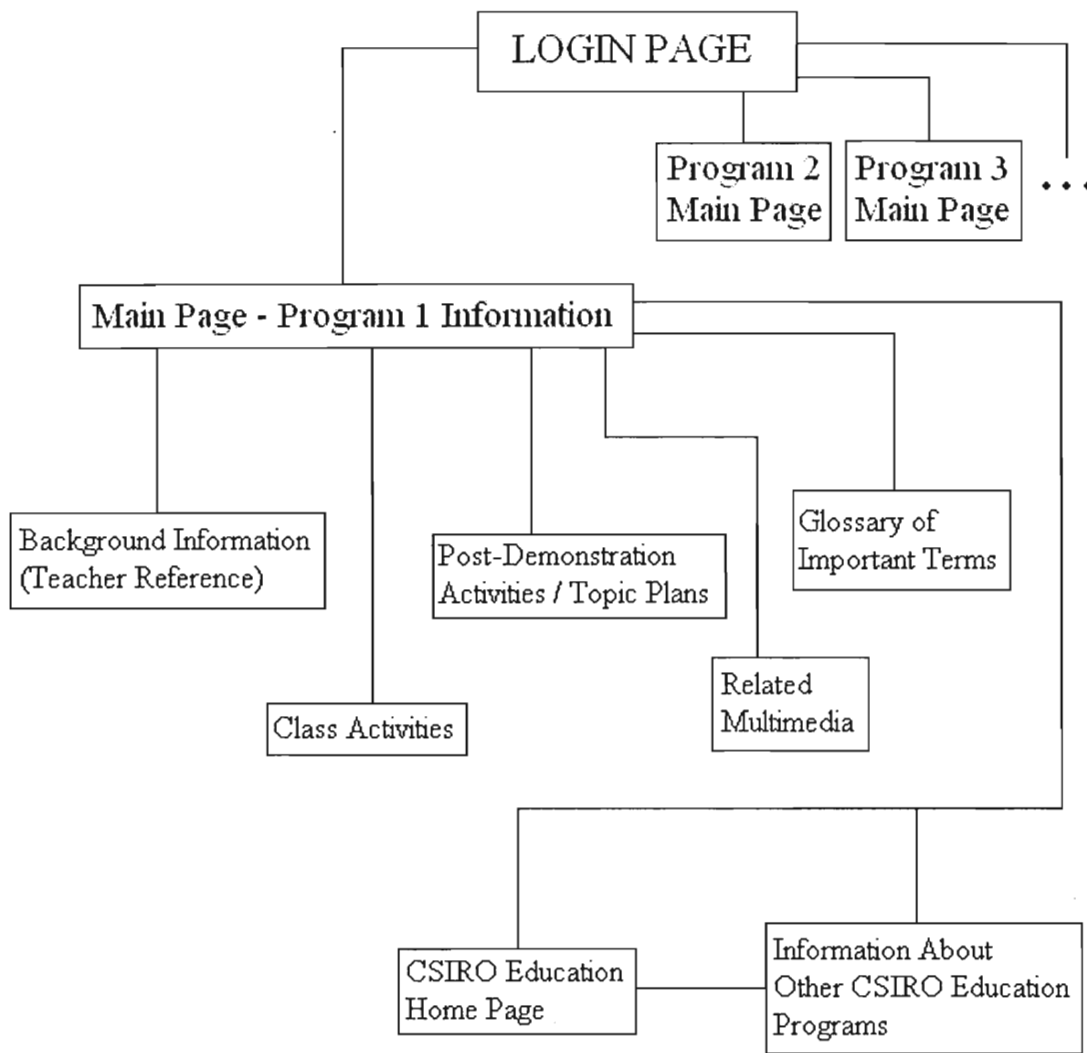


Figure 4.20: Template for incorporating features into teacher websites

This template starts with a login page for teachers, shown at the top of the diagram. After typing in a user name and password, the teacher would have access to all of the program materials that he or she had paid for, listed as the Program Main Pages. Each of these program pages would contain much useful material for the teacher's personal use. Background information would be provided in order to familiarize the teacher with program material that would be presented in the demonstration portion of the CSIRO Education program. A glossary of important terms and some multimedia demonstrations would be included as well in order to further prepare the teacher to teach relevant material to students. In another section,

CSIRO Education would recommend activities that the teacher could do in class with students to prepare them for the CSIRO Education demonstration. Similarly, the website would also include post-demonstration activities and topic plans for teachers to use, materials that would ensure that the students learn even more from their CSIRO Education experience. Finally, links would be provided to the CSIRO Education Home Page and to a page with information about CSIRO Education’s other programs.

Student Template

Figure 4.21 shows our template for creating program websites for student use.

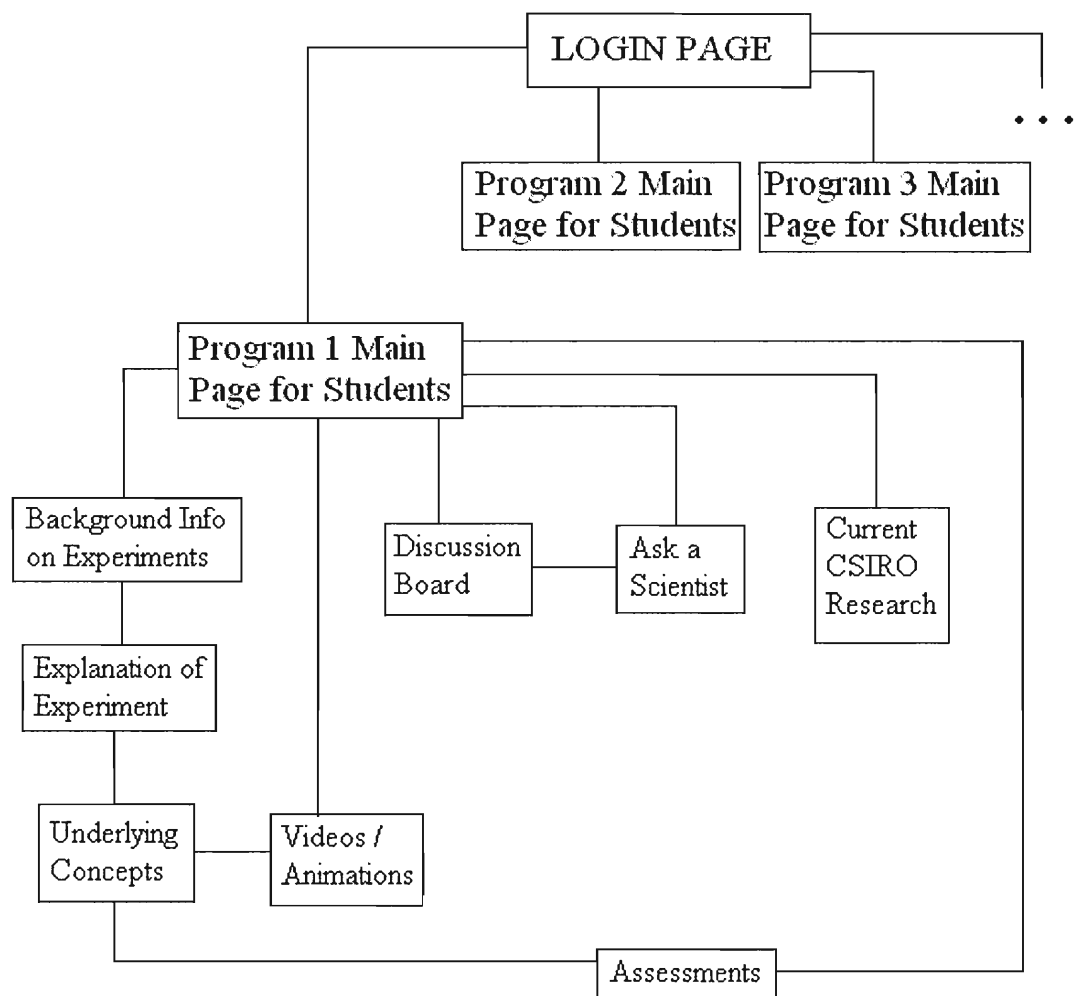


Figure 4.21: Template for incorporating features into student websites

Similar to the teacher website, the student website would feature a login page, and after students log in they would have access to the Program Main Pages that their teacher registered for. The student website would serve as a complete resource for the students to learn more about the topics presented during the live portion of the CSIRO Education program. The Background Information section would contain a thorough explanation of exactly what happened during the CSIRO Education live presentation. Furthermore, it would contain information on all of the underlying concepts behind the science demonstration. This information would be presented in the form of text with short video clips and interactive programs interspersed, all of which would combine to give the students an excellent understanding of the topic explored by the live portion of the education program. The videos and animations would also be grouped together in a link off of the main page for quick reference. The website would also have tests available for the students to take in order to assess how much they had learned. On the discussion board, students would have the opportunity to discuss the program and the science behind it.

As a further extension of the information presented, the website would include a section detailing current research being done within CSIRO that is relevant to the CSIRO Education program. Finally, students would be able to submit their questions about the topic to a CSIRO scientist in the “Ask a Scientist” section so that enthusiastic students could fully explore what professionals do in fields related to the program topic. Between the exciting, interactive background material and the opportunities to examine real-life science, the website for students would help fulfill CSIRO Education’s goal of exciting children about science and its related careers.

4.4.2 Sample Electronic Supplement

After producing the template for adding electronic media to CSIRO Education programs, we produced a website that incorporates the results of our research and creates an example of how to electronically supplement an education program. From our focus groups and teacher survey, we learned that teachers wanted more preparatory and follow-up information to be available electronically. In the student survey, we saw that not only did students regularly use computers and the Internet, but also they were generally interested in completing more activities online. These results led us to create a student website as well as a teacher oriented one, both based on our templates. Our websites incorporated these preferences by providing background information for the educational programs provided by CSIRO Education. Screenshots for every page on the websites can be found in Appendix M.

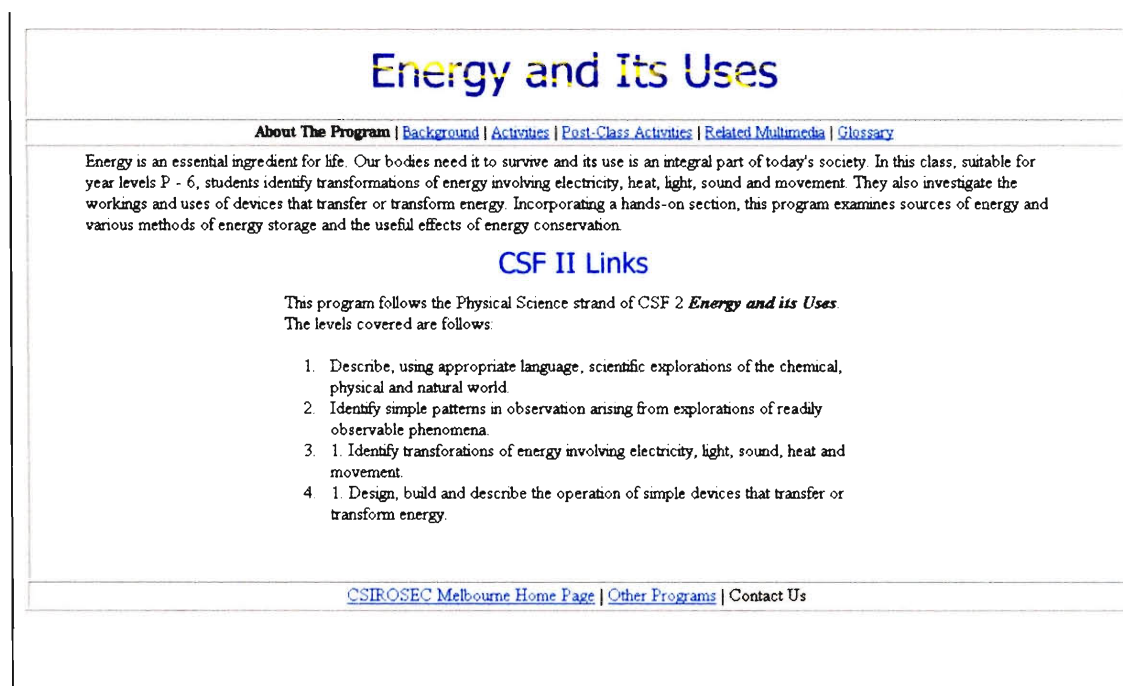


Figure 4.22: Screenshot of Main Teacher Page

The program selected for the example was “Energy and Its Uses,” a program dealing with physics concepts. This was chosen because of the popularity and ease of presenting information in the education program. We began creating the website by

researching background information on “Energy and Its Uses” given to us by CSIRO Education employees. Once this information was incorporated in the website, we sought to incorporate the interactive elements asked for by the teachers in our surveys. We did this by adding a page entitled “Related Multimedia” which contains links and which will in the future contain interactive Flash animations demonstrating concepts related to the program. The teachers’ desire for post-education program topic plans was met in a page entitled “Post-Class Activities.” This page contains ideas given to us by CSIRO Education employees on how best to follow-up the class presentation of “Energy and Its Uses.” The results of our focus groups, which said that the site must be easy to use with a simple interface, were taken into consideration when designing the layout of our page, which our liaison enjoyed because of its ease of use (Rebecca Carter, personal communication, 4/23/04).

Student Website

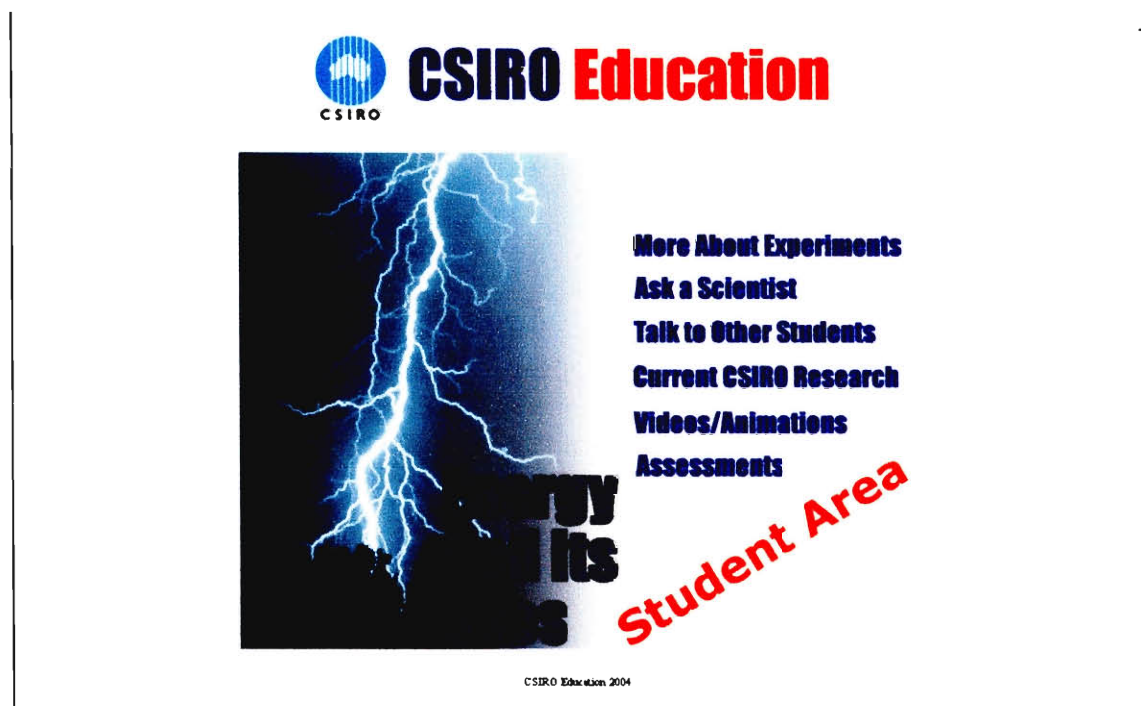


Figure 4.23: Screenshot of the Main Student Page

The website for students contains a main page designed to grab the attention of the students and pages that incorporate the interactive items requested by the majority of our survey respondents. The site contains a page entitled “More Information,” which gives students further background material on the topic presented. Another page contains videos and links to related websites for the students to visit. There is a place for a bulletin board to be implemented that would allow students to discuss the topic of the program. These features were all added in response to the opinions expressed by our survey respondents.

The two pages that were added because of feedback on our survey to teachers were the “Ask a Scientist” page, where students can ask a CSIRO researcher questions, and the “Current Research” page, where students can see what CSIRO is currently researching that is related to the education program. The inclusion of these pages would help CSIRO Education to achieve their goal of making students interested in science by putting them in touch with real scientists and cutting-edge research. The “Assessment” page was added so that teachers could have their students perform a short assessment as part of the program. This could be as simple as factual questions or could go beyond the facts and ask the students to synthesize the information presented and make conclusions based on the presentations.

The website we have proposed is simply a prototype. There may be flaws present in that not all teachers may be able to use all of the features included. Not all of these features might be financially feasible for CSIRO Education to include. The website is meant to serve as a starting point for future ideas and information to be added.

5 Conclusions and Recommendations

Through our results and analysis, we answered our research questions and gave recommendations on how CSIRO Education can use electronic media in the future. This chapter presents our conclusions and recommendations and suggests what work should be done in the future to successfully produce electronic supplements to CSIRO Education programs.

5.1 Summary of Completed Research

Our literature review examined several possible methods for using electronic media to deliver educational materials. We found that some media, such as CD-ROMs, interactive websites, and Internet video, were more feasible than media such as email or Intelligent Tutoring Systems, which were either not useful enough or too expensive for CSIRO Education to use.

Our research in Australia showed us which form of electronic delivery would be most appealing to the teachers and students of Victoria. Research revealed that many Victorian teachers were unfamiliar with the topics presented in CSIRO Education programs because of the teachers' lack of background in science. These teachers are therefore uncomfortable teaching science related material to their students and would find it very useful if CSIRO Education provided follow-up materials for programs electronically. These follow-up materials should include lesson plans for the teachers to use and multimedia-enhanced background information for both teachers and students to use. Our results also show that the background information for student use should not be only in text form, but should include videos and interactive programs, which would be combined with teacher instruction to clarify the concepts in the CSIRO Education program. Our research suggests that the

majority of Victorian teachers prefer these background and follow-up materials to be delivered on a website, although schools with unreliable Internet connections may prefer them on a CD-ROM.

We also utilized the results of our research to examine potential marketing and cost issues that could be faced by CSIRO Education when selling added electronic components to its programs. Teachers would be willing to pay extra for these electronic program additions, but only if they felt that a significant amount of extra educational materials was included in these components and they would be beneficial to the students. Our results show that a basic website on which to place program materials would be relatively inexpensive for CSIRO Education. Most of the costs involved with producing electronic components to CSIRO Education programs would lie in developing interactive programs for student use, which our survey participants saw as very beneficial additions to education programs.

Teachers tended to want features in an education program that would be convenient for both teachers and students to access. CSIRO Education could make its programs more marketable by selling a login name and password for a program website to teachers, which would be an easy way for them to pay for electronic program components and would allow access to these components at any time. CSIRO Education could market electronic program components to teachers in schools that are located far from the CSIRO Science Education Centre by providing access to video recordings of CSIRO Education's live demonstrations online. In this way, these teachers could reduce the traveling time and expenses that they currently incur with a visit to the Centre. These ideas of having a login name and password to a program website and having videos available online have great marketing potential for CSIRO Education. However, they also must be evaluated further before being implemented, because of potential problems. A login name and password might not be secure

because it could be distributed among teachers who have not paid, and if videos of CSIRO Education presentations were available online, teachers might simply buy these videos and not book live CSIRO Education demonstrations, which are more important.

A website implementation involving a content management system (as described in Section 4.3.3), although more expensive than basic web development options, would allow the costs of development to be fixed and would require minimal costs of future work by people outside of CSIRO Education. The system would provide a professional looking website that would be flexible enough to accommodate any future technologies or future uses of the CSIRO Education website. The added benefit to the consumer would be very appealing to teachers, and as seen in our focus group results, this would make teachers more willing to pay for these services.

The lower-cost implementation we examined would provide CSIRO Education with a basic website that would provide the services needed, but at a basic level. The ability in the future to update and add new content, which is something that teachers in our focus groups wanted, would be costly and less efficient than the content management system option.

The other option is to use the current company that provides the web development for the CSIRO Education site to create basic pages for a few programs at a time, and then contract out to companies for the creation of the interactive programs and animations. This option would probably not be the best financially in the long run, but if CSIRO Education integrated a few programs with electronic media at a time they would be able to make money on these additions to fund future electronically delivered supplements to their programs. This method would also eliminate the large up front costs involved with the other implementations and allow CSIRO Education to operate on a similar budget to the one used now.

The conclusions obtained from our research contributed to the development of the template for incorporating electronic media into CSIRO Education programs (Section 4.4.1). This template contains all of the features that Victorian teachers said they wanted in electronic components of CSIRO Education programs. Our results also provide an idea of how to include these features on a future program website, as seen in the example we developed (Section 4.4.2).

5.2 Recommendations

Throughout our research, we found that the addition of electronic media to CSIRO Education programs would appeal to the majority of Victorian educators. While electronic media in general are helpful for use in education, the additions of our proposed electronically delivered components stand to benefit CSIRO Education more than other electronic deliveries.

5.2.1 CD-ROM

Although the use of websites was generally preferred over the use of CD-ROMs by Victorian teachers, the fact that more than a quarter of the teachers surveyed preferred CD-ROMs does make them worth mentioning as a possible form of electronic delivery for CSIRO Education to use. A CD-ROM could be used as an in-class reference that would contain a large amount of additional information on CSIRO Education programs.

Since CD-ROMs have a large amount of storage space, they could deliver this additional information in several different ways. As some teachers suggested, CSIRO Education's live demonstrations could be recorded on video for the children to review multiple times, and accompanying text could explain what happened in the video. A CD-ROM could also include interactive programs in order to give children a visual

representation of the concepts that CSIRO Education would like to teach. This would make CSIRO Education's supplemental CD-ROM an exciting multimedia encyclopedia that would excite children about learning science.

CD-ROMs have an advantage over websites in that the material on them can be delivered to schools without reliable Internet access. However, the majority of the teachers we surveyed said that a website would be a better method than a CD-ROM. Therefore, CSIRO Education should initially invest in the development of websites to supplement its programs. If these websites prove successful, CSIRO Education could develop CD-ROM versions of the websites in order to serve those customers who find it difficult to access the Internet.

5.2.2 Website

The use of a website to deliver supplemental program material offers CSIRO Education several benefits above and beyond those offered by other electronic media, including CD-ROMs. A website has the capability to be updated easily with new material, thus offering CSIRO Education's customers added value over a CD-ROM, which cannot be easily updated once it has been produced. Websites can also provide more added value by linking to educational websites produced by others that may specialize on a topic or provide more information for students. In addition, live interaction with other students or teachers is possible online.

Incorporating a student website into each of its programs would also be very beneficial to both CSIRO Education and its customers. This website for each education program should include resources such as interactive programs, videos, and text for the student version of the site. The website for teachers should have background information to familiarize teachers with the concepts in the CSIRO Education program and topic plans to aid in teaching the material to students after the

presentation. CSIRO Education could use the templates and sample websites we have developed (Section 4.4) to ensure that it successfully incorporates all of the features that Victorian teachers want in its programs. We strongly recommend that CSIRO Education pursue the website option gradually by making it available for one program at a time. This way, it could gauge the successes and failures of its initial website and then modify this prototype website to fix its shortcomings before adding websites to its other extension education programs.

5.2.3 Marketing Issues

CSIRO Education could also use the template we proposed (Section 4.4.1) to produce programs that do not have presentations associated with them, but rather guide the teachers through concepts directly related to the curriculum requirements of Victorian schools. Our liaison, Chris Krishna-Pillay, told us that although there was a curriculum requirement in primary schools that deals with toys, CSIRO Education did not want to put the money into producing a presentation on this topic. CSIRO Education could instead implement an electronically delivered program to cover this topic. After the initial development costs, this would allow CSIRO Education to make money without paying the normal costs associated with a live presentation. CSIRO Education could also record some of its live demonstrations and make them available as videos online. This way, students who have experienced a CSIRO Education program could review what they have seen, and those students who have not experienced a CSIRO Education program due to travel distance or cost could get the chance to view it online.

This would open up a whole new way to market to people who live far away from the CSIRO Science Education Centre, since these stand alone programs could be delivered without paying the possibly high costs of transportation, which are a big

factor for non-participating teachers when choosing an extension education program. However, this new approach to marketing CSIRO Education programs should be implemented with caution, because if teachers could pay significantly less for an electronic version of a program, they might not book the live demonstration portion of CSIRO Education's programs. To prevent CSIRO Education's business from being undermined in this way, we once again recommend that the company implement its program websites one program at a time. This way, CSIRO Education will have time to measure the potential impact of its electronic supplements on its business.

CSIRO Education wants to maintain the level of quality shown in their presentations in whatever electronic media they put forth to their customers. In order to accomplish this, it should progress with this integration of electronic media into its education programs slowly and produce quality websites one at a time instead of producing something for all programs that does not meet its standards of excellence. We recommend that CSIRO Education accomplish this progressive integration by using its current web development company to create pages for one or two programs. CSIRO Education could then hire outside companies to produce interactive programs and animations to add to these initial websites. This would allow CSIRO Education to test its market, and if these test websites prove to be effective, electronic media could be integrated into other programs.

5.2.4 Integration of Electronic Media with CSIRO Education

Programs

Using a website, CSIRO Education could deliver different forms of supplemental information for its extension education programs. The integration template and sample website we developed (Section 4.4.1) have all of these features

included, and so we recommend that CSIRO Education use the template and website to their fullest when incorporating electronic media into their programs.

5.3 Future Work

While our research looked into the subject of adding electronic media to CSIRO Education programs, there still exists much to be done. After completing our project, we discovered several new facets to this issue, which could be worked on in the future.

There are dimensions to the incorporation of electronic media that we were not able to examine. Our work focused around the usefulness of incorporating electronic media into CSIRO Education's presentations, but work can still be done examining the feasibility of incorporating these media into other aspects of CSIRO Education, particularly into its educational publications.

Throughout our investigation, teachers expressed a strong interest in online lesson plans that would integrate CSIRO Education's demonstration with Victorian curriculum requirements. Future work could investigate precisely what teachers would like to see in such material and then use the teachers' suggestions to develop lesson plans specific to each CSIRO Education program.

We found that the incorporation of electronic media into CSIRO Education's programs will be a costly venture. The company would benefit greatly from a project done to investigate possible funding sources for the development of a website or CD-ROM.

CSIRO Education could also use help in developing material to put on a future website or CD-ROM. One possible project is determining the aspects of each of CSIRO Education's programs that could be incorporated into the company's electronically delivered supplements in order to make these supplements complete

and valuable to teachers. A separate major project that will need to be accomplished is compiling and preparing all of the supplementary material and information that must be included in CSIRO Education's website or CD-ROM.

After CSIRO Education has developed a prototype of an electronically delivered component for one of its programs, it will need to be evaluated. A marketing study could be performed on this prototype in which researchers would determine what price the product could be sold for, how to best advertise it, and how it could be improved. In addition, the effects of this electronically enhanced program on the sales of current programs should be examined to make sure that CSIRO Education has not added electronic components that could actually harm its regular program activities. A usability study should also be done on this prototype so that its effectiveness in terms of how much students learn from it could be evaluated.

References

- Al-Nuaimy, Waleed, Zhang, Jinghua, & Noble, Alan. (2001). Web-based learning environment for a communications module. Computer Applications in Engineering Education, 9(2), 114-121.
- Allen, I. E., & Seaman, J. (2003). Sizing the Opportunity: The Quality and Extent of Online Education in the United States, 2002 and 2003. Retrieved February 7, 2004 from http://www.sloan-c.org/resources/sizing_opportunity.pdf.
- Bickman, Leonard, & Rog, Debra J. (eds.). (1998). Handbook of Applied Social Science Research Methods. Sage Publications: Thousand Oaks.
- Brigham, D. (2001). International Review of Research in Open and Distant Learning. Converting Student Support Services to Online Delivery. Retrieved February 6, 2004 from <http://www.irrodl.org/content/v1.2/regents.html>.
- Castro, M., Lopez-Rey, A., Pérez-Molina, C. M., Colmenar, A., Morade, C., Yeves, F., Carpio, J., Peire, J., & Daniel, J.S. (2001). Examples of Distance Learning Projects in the European Community. IEEE Transactions on Education, 44(4), 406-411.
- Cloete, Elsabé. (2001). Electronic education system model. Computers & Education, 36(2), 171-182.
- Commonwealth Scientific & Industrial Research Organization (CSIRO). (2003). Education Programs: CSIRO Education Victoria. Retrieved January 28, 2004 from <http://www.csiro.au/melbcsirosec/programs/index.html>.
- CSIRO Education. (2003). The CSIRO Education Victoria Homepage. Retrieved January 26, 2004 from <http://www.csiro.au/melbcsirosec/>.
- CSIRO Education Victoria. (2002). CSIRO Education, Victoria Annual Report. Victoria, Australia: CSIRO.
- CSIRO Publishing. (2004). CSIRO Publishing- Excellence in Science Publishing. Retrieved March 22, 2004 from <http://www.publish.csiro.au>.
- Coppola, Brian P. (2001). Full Human Presence: A Guidepost to Mentoring Undergraduate Science Students. New Directions for Teaching and Learning (85), 57-71.
- Davis, B.G. (1993). Motivating Students. Retrieved January 31, 2004 from <http://teaching.berkeley.edu/bgd/motivate.html>.
- Denzin, Norman K., & Lincoln, Yvonna S. (eds.). (1994). Handbook of Qualitative Research. Sage Publications: Thousand Oaks.

Douglas, Matthew James, King, Jessica Anne, & Meleschi, Shangari Benin. (2001). Participation in CSIRO Education Programs. Unpublished IQP report advised by Ault, H. K. WPI, Worcester, MA.

Dweck, C. S. (2000). How Can Teachers Develop Students' Motivation – and Success? Retrieved January 31, 2004 from http://www.education-world.com/a_curr/curr197.shtml.

Evans, Joel R., & Berman, Barry. (2002). Marketing in the 21st Century. Cincinnati, OH: Atomic Dog Publishing.

Gregory, Vicki. (2003). Student perceptions of the effectiveness of Web-based distance education. New Library World, 104(1193), 426-431.

Gubrium, Jaber F., & Holstein, James A. (eds.). (2002). Handbook of Interview Research: Context & Method. Sage Publications: Thousand Oaks.

Halpern, Diane F. (2002). Learning That Lasts a Lifetime: Teaching for Long-Term Retention and Transfer. New Directions for Teaching and Learning (89), 3-7.

Heilbrunn, Jeffrey (ed.). (1995). AMA Marketing Encyclopedia: Issues & Trends Shaping the Future. Chicago: NTC Business Books.

Hoffman, Joseph L., Wu, Hsin-Kai, Krajcik, Joseph S., & Soloway, Elliot. (2003). The nature of middle school learners' science content understandings with the use of online resources. Journal of Research in Science Teaching, 40(3), 323-346.

Hussain, Yusuf & Toor, Aymen (2001). True Costs of Developing Software. Retrieved April 23, 2004 from <http://www.cressoft.com>

Keller, John M. (1999). Using the ARCS Motivational Process in Computer-Based Instruction and Distance Education. New Directions for Teaching and Learning (78), 39-47.

King, B., McCausland, H., & Nunan, T. (2001). International Review of Research in Open and Distant Learning. Converting To Online Course And Program Delivery: The University Of South Australia Case Study. Retrieved February 6, 2004 from <http://www.irrodl.org/content/v1.2/unisa.html>.

Kinser, Kevin. (2003). Diversity Within the Virtual Classroom. New Directions for Institutional Research (118), 69-77.

Klein, David, Myhill, William, Hansen, Linda, Asby, Gary, Michaelson, Susan, & Blanck, Peter. (2003). Electronic doors to education: study of high school website accessibility in Iowa. Behavioral Sciences & the Law, 21(1), 27-49.

Lumsden, L.S. (1994). Student Motivation to Learn. ERIC Digest, 92.

Moore, Michael, & Kearsly, Greg. (1996). Distance Education: A System View. Belmont, MA: Wadsworth.

- Newton, Robert. (2003). Staff attitudes to the development and delivery of e-learning. New Library World, 104(1193), 412-425.
- Oxxus. (2003). Web Hosting Plans. Retrieved 2/21/04 from <http://www.oxus.net/resources/Linux/Intro-Linux-161.html>.
- Phelps, Julia, & Reynolds, Ross. (2001). Issues surrounding the embedding of a Web-based course. Computers & Education, 36(3), 207-222.
- Rifkin, G., & Perelman, L. (1990). Can Technology effectively replace human teachers? Computerworld(24), 25.
- Sangra, Albert. (2002). A New Learning Model for the Information and Knowledge Society: The Case of the UOC. International Review of Research in Open and Distance Learning. Jan-2002. Retrieved 2/7/04 from <http://www.irrodl.org/content/v2.2/sangra.html>.
- State of Victoria Department of Education and Training. (2002). SOFWeb. Retrieved March 22, 2004 from <http://www.sofweb.vic.edu.au>.
- Sowter, Colin V. (2000). Marketing High Technology Services. Hampshire, England: Gower Publishing.
- Stacey, Elizabeth. (1994). Technology overcomes Australian distances. T.H.E. Journal, 21(6), 56-59.
- Technological Horizons in Education. (1998). Distance Learning Brings the World to Students in Remote Areas. T.H.E. Journal, 26(5), 44.
- Underwood, Geoffrey, & Underwood, Jean D. M. (1998). Children's interactions and learning outcomes with interactive talking books. Computers & Education, 30(1-2), 95-102.
- West Australian Networks. (2004). Web Hosting. Retrieved 2/21/04 from <http://www.westnet.net/westnet/hosting/index.php?content=10>.
- Woods, Douglas W. (2001). Handbook for IQP Advisors and Students. Retrieved February 22, 2004 from <http://www.wpi.edu/Academics/Depts/IGSD/IQPHbook/>.
- Yu, Fu-Yun, & Yu, Hsin-Ju Jessy. (2002). Incorporating e-mail into the learning process: its impact on student academic achievement and attitudes. Computers & Education, 38(1-3), 117-126.
- Zhang, Weiyuan, Niu, Jian, & Jiang, Guozhen. (2002). Web-Based Education at Conventional Universities in China: A Case Study. International Review of Research in Open and Distance Learning. Jan-2002. Retrieved 2/7/04 from <http://www.irrodl.org/content/v2.2/zhang.html>.

Appendix A: Phone Protocol for Encouraging Responses

Hello, this is _____, calling on the behalf of C-S-I-R-O Education in Highett.

About a week and a half ago, we sent a survey to your school addressed to the science coordinator or principal, and I was wondering if I could please speak to the science coordinator at this time?

WAIT FOR RESPONSE

Hi, my name is _____. A couple of other students and I are conducting a research project on the behalf of C-S-I-R-O Education involving the use of electronic media in education, and about a week and a half ago, we sent a survey to your school. I was just wondering if you got the chance to complete and send it back to us yet.

“I HAVEN’T GOTTEN THE CHANCE YET”:

We understand that this is a busy time of year for you. It’s really important to us to get your feedback. We are only here for our project for seven weeks in total, so we would really appreciate it if you could get the questionnaire back to us as soon as possible.

“I NEVER RECEIVED THE SURVEY”:

We’re sorry to hear that. We would be happy to get you one as soon as possible.

Would you prefer to receive the questionnaire by mail, fax, or email?

TAKE INFO.

“I ALREADY MAILED IT BACK TO YOU.”

That's great to hear. Thank you very much for your input, and have a great day.

Appendix B: Teacher Survey



CSIRO Education Centre
PO Box 56
Highett VIC 3190

March 15, 2004

Dear Victorian Teacher,

This survey is part of a study investigating the feasibility of incorporating electronic media (Websites, CD-ROM's, etc.) into extension science education programs, particularly those offered by the Commonwealth Scientific and Industrial Research Organization (CSIRO) Science Education Centre in Victoria. Students of the Worcester Polytechnic Institute, located in Worcester, Massachusetts, USA, are conducting this study in cooperation with the CSIRO Science Education Centre in Highett, Victoria. The results of this survey will be disseminated widely and used to improve the use of new technologies in the programs of CSIRO.

Your school was selected from among a listing of schools in the state of Victoria. As a teacher of science, your input on the types of electronic media that would be helpful to your curriculum is essential to improving program development. Your responses to all parts of this survey will be pooled with other responses and will remain strictly confidential. A code consisting of an identifying number will be placed in the upper right-hand corner of the first page of the survey. This number provides a mechanism by which we can track responses and possibly contact educators who have not returned the survey. Please be assured, your responses will remain confidential.

This survey is three pages long, consisting of three topics for all teachers, and then a topic which you answer the questions under the section that describes you. Please fill it out as soon as possible and mail it back to us in the enclosed postage-paid envelope. Your responses will help to determine the best ways to incorporate technology into the educational programs of CSIRO.

Thank you for your timely response to this survey.

Sincerely,

Richard Adams,
Sean Doherty,
Anthony Smith
Worcester Polytechnic Institute



Year Level: _____

Location: _____

Type of School Public Catholic Independent



The following survey consists of questions on four topics related to using technology with CSIRO Science Education programs.

The first topic asks general questions about CSIRO Science Education programs and what could be added to them, while the remaining topics relate to specific uses of technology with CSIRO programs.

Upon completion, please fax to 9252 6256 OR use the enclosed envelope to return this survey to:

**CSIRO Science Education Centre
PO Box 56
Highett VIC 3190**

Please circle your responses.

1. Do you feel the following items would make CSIRO's programs more appealing?
(1 = Not at all, 2 = Probably not, 3 = Perhaps, 4 = Most likely, 5 = Certainly yes)

Materials that would allow students to research presented topics more in depth	1	2	3	4	5
Materials that would allow students to repeatedly review information	1	2	3	4	5
Materials that would allow students to simulate demonstrated material	1	2	3	4	5
Something to test/reinforce the material learned	1	2	3	4	5
Lessons to use after the demonstrations to supplement the performance	1	2	3	4	5
A website to facilitate discussion among students on scientific topics	1	2	3	4	5

2. Please rank the following types of electronic media in order of what would be helpful to you by placing a number in front of the item. (1 = most important, 2 = 2nd most important, and so on)

- _____ CD-ROM
- _____ Website of Information only
- _____ Website with interactive elements (discussion boards/online demonstrations)
- _____ Videos of presentations for viewing on the Internet
- _____ Other _____

3. Would any of the following additional materials for a CSIRO program appeal to you?

(1 = Not at all, 2 = Not very much, 3 = Somewhat, 4 = Yes, 5 = Very much so)

Also, please circle the format that would be most useful to you (CD-ROM or Website)

Preparatory information for students to access	CD-ROM	Website	1	2	3	4	5
Preparatory lessons/information for teachers to use	CD-ROM	Website	1	2	3	4	5
Follow-up information for students to access	CD-ROM	Website	1	2	3	4	5
Follow-up lessons/information for teachers to use	CD-ROM	Website	1	2	3	4	5
Internet Video Feed (web streaming) of CSIRO presentations			1	2	3	4	5
How willing would you be to pay extra for these services?			1	2	3	4	5

What other types of delivery would be helpful? _____

If you HAVE NOT participated in CSIRO Victoria's programs, please answer the following section:

Please state your level of agreement with the following statements:

(1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree)

The travel expenses involved are an important issue when considering an extension education program.	1	2	3	4	5
A CD-ROM would make programs more appealing.	1	2	3	4	5
A website would make programs more appealing.	1	2	3	4	5
Program content is an important issue when considering an extension education program	1	2	3	4	5
Follow-up materials have made programs more useful/appealing.	1	2	3	4	5

If you HAVE participated in CSIRO Victoria's programs, please answer the questions on the following page:

For each program you have participated in, please answer the following questions about how helpful the program was to you:

(1 = Not helpful, 2 = Slightly helpful, 3 = Moderately helpful,
4 = Very helpful 5 = Extremely helpful)

Program 1:

Which program did you participate in? _____

- Was the program helpful in fulfilling a curriculum requirement set by your school? 1 2 3 4 5
- Was the program helpful in fulfilling an assessment requirement set by your school? 1 2 3 4 5
- Did you feel the program was adequately followed up? 1 2 3 4 5
- Would you find more follow up material helpful? 1 2 3 4 5
- Would a CD-ROM be helpful in supplementing this program? 1 2 3 4 5
- Would a website be helpful in supplementing this program? 1 2 3 4 5

Program 2:

Which program did you participate in? _____

- Was the program helpful in fulfilling a curriculum requirement set by your school? 1 2 3 4 5
- Was the program helpful in fulfilling an assessment requirement set by your school? 1 2 3 4 5
- Did you feel the program was adequately followed up? 1 2 3 4 5
- Would you find more follow up material helpful? 1 2 3 4 5
- Would a CD-ROM be helpful in supplementing this program? 1 2 3 4 5
- Would a website be helpful in supplementing this program? 1 2 3 4 5

Program 3:

Which program did you participate in? _____

- Was the program helpful in fulfilling a curriculum requirement set by your school? 1 2 3 4 5
- Was the program helpful in fulfilling an assessment requirement set by your school? 1 2 3 4 5
- Did you feel the program was adequately followed up? 1 2 3 4 5
- Would you find more follow up material helpful? 1 2 3 4 5
- Would a CD-ROM be helpful in supplementing this program? 1 2 3 4 5
- Would a website be helpful in supplementing this program? 1 2 3 4 5

Finally, please write down any comments you have on how you feel electronic media such as e-mails, CD-ROMs, and interactive websites could be used to supplement CSIRO Education programs:

Appendix C: Focus Group Interview Guide

1. **Do you feel that utilizing electronic media for education is important?**

Why?

2. **What electronic media are available at your school?**
3. How are electronic media used in your own education programs?
4. What do you feel are the advantages of using electronic media in education?
5. What do you feel are the shortcomings of electronic media for education?

CSIRO's Programs and Potential Electronic Components

6. Do you think CSIRO's programs could be improved with the addition of some electronic component, whether it be e-mail feedback, follow-up chats, or an informational website?

CD-ROM:

7. **Do you think that a CD-ROM software package with extra information on the subject presented in a program could provide a good amount of extra value to the program?**
8. How complex would you expect this software package to be?
9. **Could you place a dollar value on an extra CD-ROM if it met your expectations?**

Streaming Video:

10. How do you feel the use of streaming video could benefit a typical CSIRO Program?
11. Do you think that streaming video online could effectively reach out to students who live very far from the CSIRO Education Centre and provide the same quality of information?

Website:

- 12. How do you feel a course-specific website could be used to enhance the program?**
13. At what stage in the program would it be best for the website to be used?
14. What kind of features should a website for a program have?
- 15. Could you place a dollar amount on the value that this course website would add?**

Integration:

16. How could the technologies we discussed be used in conjunction with each other to add value to a typical CSIRO Education program?
- 17. How would a program benefit from a website being the basis for accessing text information, e-mail addresses, conducting chat rooms, and perhaps having video clips?**
- 18. Are there any additional comments that anyone would like to make on any issue we have discussed?**

- Thank everyone for their time, wish them well, and leave on a great note.

Appendix D: Focus Group Transcripts

Transcript of 1st Focus Group

Date: March 18, 2004

Location: CSIRO Education Centre, Highett, Victoria

Moderator: Sean Doherty

Recorder: Richard Adams

Subject: How can Electronic Media Benefit Extension Education Programs?

Start time: 5:15 PM

Sean started off the session by introducing himself and Rick. He then described our project, saying that we are American students from Worcester Polytechnic Institute who are examining teachers' feelings on electronic media (such as CD-ROMs or the Internet) in education on the behalf of CSIRO Education of Victoria.

He then started off with some general questions:

Question 1: Do you feel that utilizing electronic media for education is important, and why?

T1: Yes, because the kids seem to be more engaged in the material.

T2: I don't think that the kids are getting as much out of it because they are paying too much attention to the pictures and pretty background. They do not learn to summarize things themselves; they do a lot of cutting and pasting to answer questions. The technology has to be used in the company of the old stuff.

T3: It works well if there is an interactive program involved.

T4: If kids know that there is a purpose to electronic learning, then they get into it.

T2: You have to start the new technology stuff with the younger kids.

T5- I teach 2nd grade and have done Power Point Presentations with them before but it is a waste of time. Kids need to present material verbally to you so that you know that they understand concepts. That helps eliminate the cutting and pasting. You can't use electronic media all the time.

Question 2: What do you see as the advantages and disadvantages of using these media for educational purposes?

T2: I have used a website before, and kids have responded well to my stuff on the site.

T3: For there to be any advantages, you want the technology to be easy and fun to use.

T5: Its important for a CD or website to have background material on the subject it covers.

T4: Stuff goes out of date quickly, and a CD or website would be a great thing because it can be updated easily.

T6: Web info can be updated easily which will keep teachers up to speed on new developments in a subject.

Question 3: Do you think that CSIRO's education programs and other extension education programs could be improved with the addition of some electronic component, whether it be e-mail feedback, follow up chats, or an informational website?

T7: It would be good to have some kind of website in which you could click on your grade level and then get background for the given topic.

T2: I teach the 11th grade and teachers need background on geology and astronomy.

Question 4: Could you place a dollar value on an extra CD-ROM if it met your expectations?

T2: It's hard to say because there are already websites out there that have free information on them.

Question 5: How do you feel the use of streaming video could benefit a typical CSIRO education program?

T3: It would be good for country schools.

T7: You could cross-reference the videos and programs on the web.

Closing Comments:

All: Students need to be able to manipulate stuff on the program.

T7 Quizzes are a good thing to put online.

T2- Animations are good to put on a computer, like the physics ball drop. Quizzes are not all that good because it is too easy for kids to cheat online.

End: 5.45 PM

Transcript of 2nd Focus Group

Date: March 24, 2004

Location: Camberwell Grammar School – Camberwell, Victoria

Moderator: Anthony Smith

Recorder: Richard Adams

Subject: How can Electronic Media Benefit Extension Education Programs?

Start time: 12:50 PM

Anthony started off the session by introducing himself and Rick. He then described our project, saying that we are American students from Worcester Polytechnic Institute who are examining teachers' feelings on electronic media (such as CD-ROMs or the Internet) in education on the behalf of CSIRO Education of Victoria.

He then started off with some general questions:

Question 1: Do you feel that utilizing electronic media for education is important, and why?

T1: It is very important.

(Asked why by Anthony)

T1: Very simply, it will be preparation for entering the increasingly technologically oriented society that we live in.

T2: When kids learn by different means such as on computers, it helps everyone because they enjoy it more. It also makes a lot of information available right there at their fingertips.

Question 2: What kinds of electronic media are available at your school?

T1: All students at this school from years 9-12 have laptops and access to the Internet at any time on campus.

T3: For the middle school, there are three computer labs, which has proven to be enough for everyone.

Question 3: What do you see as the advantages and disadvantages of using these media for educational purposes?

T5: One of the advantages is that children are able to do more "hack work" that involves trial and error.

T4: Learning on computers has the potential to be much more interesting than normal, especially with interactive work. On the other hand, if there were a web page made with only words on it, it would be no better than a book. On a computer, students could get instant feedback on an informal test or some other assessment with closed-format answers. Or, revisions to a document could be tracked, as well as a student's progress on such a written assignment.

T3: The opportunity for the students to make their own web page would be great.

Question 4: Do you feel that CSIRO's extension education programs could be improved with the addition of some electronic component?

T2: I have never booked a CSIRO education program or even heard of CSIRO Education.

(The rest of the teachers concurred with this.)

T2: CSIRO should advertise better.

(Anthony then asked them if they felt that other education programs they had participated in could be improved with an electronic component.)

T1: We have experienced a wide variety of extension education programs, from completely pointless wastes of money to excellent programs. So, it's hard to tell, but these other programs could probably benefit from some sort of additional lessons to go with them.

Question 5: Do you think that a CD-ROM software package with extra information on the subject presented in a program could provide a good amount of extra value to the program?

T4: Any such CD-ROM should be applicable to many aspects of a curriculum. It should not just carry additional information about one demonstration or activity because that would not be worth much extra, certainly not enough to pay extra. Instead, it should carry a broad range of information about a topic.

T3: The actual presentation part of the education program could demonstrate the concepts presented in the CD-ROM.

Question 6: How do you feel a course-specific website could be used to enhance a program, and how useful would it be relative to a CD-ROM?

(There was a general consensus among the teachers in the room that a website would be more useful than a CD-ROM.)

T5: Something on the Web can and should be updated regularly, giving it an advantage over CD-ROMs in which the content might become obsolete quickly.

T1: A website could be used as a springboard to more information that the CD already covered.

T4: The website would be useful as long as it stuck to the more interactive side of things.

Question 7: How do you feel streaming video of presentations could be used to enhance a program?

T1: Video feeds are blocked by the firewall there, so they would not be of much use.

Question 8: We realize that you are on your lunch break so we are going to conclude soon. Are there any additional comments that anyone would like to make on the topic we have discussed?

T2: Many companies produce complete junk that is as mindless as their ill-conceived education programs. For example, a CD with only text on it is not of much use, and is very aggravating to receive. What is great about CD's is that you can do things that cannot be done in the class. Dangerous things could be recorded on a CD such as reactions with all of the elements of the periodic table. I have seen a video series on analytical instruments that were too expensive to actually have in the classroom, which I thought was a great idea.

T4: CSIRO should advertise with science organizations, or post in scientific magazines that teachers receive each week.

T5: A website would be great, with customers paying to receive a logon name and password access that would be good for a year or something.

T3: Having a free trial period with a logon-based website might be an excellent idea.

Transcript of 3rd Focus Group

Date: April 16, 2004

Location: CSIRO Science Education Center, Highett, Victoria

Moderator: Anthony Smith

Recorders: Richard Adams, Sean Doherty

Subject: How can Electronic Media Benefit CSIRO Extension Education Programs?

Start time: 10:05 PM

Anthony started off the session by stating that after getting the opinions of teachers on how electronic media can be used in education programs, we need the opinions of CSIRO Education officers on this subject because they know these programs best.

He then began the questions and discussion:

Question 1: Do you feel that utilizing electronic media for education is important in general, and why?

Simon Matheson (SM): It has its place, but it is not totally important. Of course, when teaching science, there is a general reliance on technology anyway.

Simon Upchurch (SU): I think our programs specifically could benefit from some kind of Web-based follow-up. The costs involved would probably be the main issue with this. As far as using electronic media right in our current programs, that would be difficult. Carrying expensive stuff like laptops and projectors around is certainly an issue. That kind of decision would really come down to the issues of money and replace ability.

SM: One of the best things about our programs is that they are live, and so much of the material can't simply be presented on a screen.

Question 2: What do you feel are the advantages that come with using electronic media for educational purposes?

Jonathan Shearer (JS): For the schools, I think that it's better, since that is the direction the world is moving in today, toward the use of technology.

SU: If we were to put too much of our program material on the Web, it might undermine our business. Why book us if you can get all the information you need already assembled on the web? The Internet is good for catering to different learning styles of kids. Using the Internet is important, but we have to be careful.

SM: The Internet is really commonly used now, so an advantage to using it is that it is the way kids are used to seeing information presented. But, the whole point of our

programs is to do stuff differently with the kids. They are used to using the Internet to access information, but our stuff is good because it is less high-tech and more hands-on. As far as using the Internet to send teachers preparatory information, that might not work out so well.

SU: Half of the preparatory stuff we send out doesn't get read by the teachers anyway.

SM: I would say sending out prep stuff isn't really important. Follow-up might be good, but there is not a lot to be gained with prep material.

JS: It would be good to have follow-up things you could look at on the Web.

SU: Yes, I like that idea.

SM: The problem is computer availability. When I was a teacher, I would have to book the computer lab weeks in advance, and I'm sure it's the same way at many other schools.

Question 3: What would you say are the most important aspects of CSIRO's programs for the children's learning?

SM: The programs are meant to introduce ideas for the teachers to then follow up on. They are not designed to actually teach the kids the material, so in that respect the students do not learn. They are great as a way of introducing material and giving the kids enthusiasm.

SU: I would say the hands-on approach caters to different learning styles of different children.

SM: Our programs also cater to the kids' short attention spans, because they are only 1-2 hours long. Kids like things that are short, quick, easy, and fun.

Question 4: Do children ever ask you follow-up questions on the material presented?

SM: The kids will ask questions, if we let them, which happens if we have enough time at the end of a presentation.

SU: The kids do want to know more sometimes.

Andrea Nelson (AN): The teachers themselves would like to know more, when they can get it, especially Year 12 teachers who teach more complex material.

Question 5: Do you think that a CD-ROM software package with extra information on the subject presented in a program could provide a good amount of extra value to the program?

SU: A CD is a concrete thing, so teachers would probably be more willing to pay for something they could hold in their hand than something like a website. Teachers don't like websites because the address could change, but a CD is solid and can't change.

SM: Since each program has specific information for it, we might want to make different CD's for different programs, but that wouldn't fill up much on each CD.

Question 6: How could video recorded demonstrations or other materials be useful?

SM: The video could easily go on the CD. Again though, we don't want to undermine our business by making all of our material available on CD.

SU: A generic CD with links to sites on the Web would probably be a good idea. A lot of teachers would probably prefer to have material available on a CD because the servers at their schools don't work well.

Question 7: How else do you think a website could benefit CSIRO's programs?

SM: The website we have right now is just promotional, for the teachers to select a program they'd like, but I'm sure other things could go online. Perhaps we could do web-based booking for our programs.

SU: I like the idea you mentioned of having a logon name and password that the teachers could pay for to receive access to a website until a limited time expires.

AN: I think the teachers would like to have some sort of lesson plan available for after the live demonstration.

SM: We shouldn't make whole lesson plans available, but perhaps we could come up with topic plans for the teachers.

AN: Yeah, that would be a good idea. Teachers may need help to link our program to their lessons.

SM: Primary school teachers might not know much about science, but at the upper levels, we assume that teachers know what they are doing.

Question 8: Are there any additional comments that anyone would like to make on any issues we have discussed?

SU: I really like the idea of using electronic media for follow-up information, and I think it could definitely add more value to our programs.

Transcript of 4th Focus Group

Date: April 19, 2004

Location: Sacrecoeur Catholic School

Moderator: Sean Doherty

Recorder: Richard Adams

Subject: How can electronic media benefit CSIRO Extension Education Programs?

Start Time: 3:35 PM

Sean started off the session by introducing himself and Rick. He then described our project, saying that we are American students from Worcester Polytechnic Institute who are examining teachers' feelings on electronic media (such as CD-ROMs or the Internet) in education on the behalf of CSIRO Education of Victoria.

He then started off with some general questions:

Question 1: Do you feel that utilizing electronic media for education is important and why?

T1 – It would be useful to compile videos about topics on one website. Examples of physics and biology videos would be helpful to demonstrate concepts to the students.

T2 – It would be good for follow-up material.

T3 – It would be helpful if the information on a website was sorted by year level for the program

T2 – A website would be a good tool to use to aid the students learning.

Question 2: Would you be willing to pay money for some thing like`this?

T4 – Yes we would be willing to pay a little extra.

Question 3: Would a website for teachers be helpful?

T5 – It would be helpful for teachers to have website to gather information

T6 – It would be helpful if the information were tailored to the program principles.

T3 – It would be great if you could extend the programs with related projects and give the teachers the answers to them.

T6 – That would be helpful for primary teachers because they are not comfortable with teaching science.

T3 – It would be good to have material that integrates easy into the curriculum.

T6 – It would be easier to validate, and receive funding if the material was related to the curriculum.

T3 – Schools would probably subscribe to the website if it was extremely useful and closely related to the curriculum.

T6 – If the program is easy to justify then more teachers will purchase it.

T3 – More programs need to be focused toward secondary schools.

Question 4: What kind of technology do you have available at your school?

T3 – Our school is looking into getting data projectors.

T7 – Computers are not always available and the Internet is not always working.

T3 – CD's would be good for the school because we can use them even when the Internet is down.

T2 – A website would be good because then the students can view the website from home.

End: 4:05

Appendix E: Focus Group Summaries

Summary of 1st Focus Group

Date: March 18, 2004

Location: CSIRO Education Centre, Highett, Victoria

Participants: 10

School Type: Government

Moderator: Sean Doherty

Recorder: Richard Adams

Subject: How can Electronic Media Benefit Extension Education Programs?

Start time: 5:15 PM

End time: 5:45 PM

1. The potential for electronic media **increasing the enthusiasm or motivation of students** was discussed four times in the conversation. To the teachers, students seemed to be more engaged in material when it was presented on a computer. They felt that electronic education could be very advantageous as long as it was easy to use and fun material was presented, such as animations.
2. Twice, the need for the program to be **interactive** was discussed. All of the teachers agreed that students need to be able to manipulate an electronic program in some way for it to be useful.
3. One teacher was particularly **concerned about students cheating** during online assessments. He felt that it was too easy for them to simply cut and paste answers during online quizzes.
4. The same teacher who was concerned about online assessments felt that **electronically delivered education must always be used along with traditional teaching**. Another teacher agreed with him, saying that kids need to present their knowledge verbally in order to truly prove that they understand particular concepts.
5. One respondent felt that electronic education was important in order to **keep children accustomed to using computers and technology**.

6. On six separate incidents, **the Internet** was discussed as a good means of delivering program materials, primarily as a method of delivering up-to-date background material (see below).
7. The use of **CD-ROM's** for delivery was discussed twice, but both times was followed by an assertion that a website could meet or exceed its benefits.
8. The topic of **background information** on a subject being delivered electronically was brought up four times. One teacher explicitly stated that teachers in general need this background information, especially in more specialized topics like geology or astronomy.
9. Two teachers said that electronic delivery, especially a website, would be particularly useful because it could be **easily updated** with new information about a subject.
10. The teachers were reluctant to place a **dollar value** on a CD-ROM because as one teacher said, there are already plenty of websites out there with free information on them.
11. One teacher said that online resources such as streaming video would be good for **reaching out** to country schools that CSIRO programs do not normally reach to.
12. On the subject of **online quizzes**, one teacher felt that they were a very good thing to put online, while another teacher thought that students tended to cheat on these quizzes or not learn much because they could simply cut and paste the answers to the quizzes from the web pages with the actual information on them.

Summary of 2nd Focus Group

Date: March 24, 2004

Location: Camberwell Grammar School – Camberwell, Victoria

Participants: 5

School Type: Independent

Moderator: Anthony Smith

Recorder: Richard Adams

Subject: How can Electronic Media Benefit Extension Education Programs?

Start time: 12:50 PM

1. On two instances, teachers said that electronic media certainly has the potential to **increase students' motivation** for learning material, because it is through different means than normal.
2. The teachers felt that electronic media would be useful only if the material presented was **interactive**, saying something like a web page with only words on it would be no better than a book.
3. One teacher felt that students' using electronic media is necessary as **preparation for the increasingly technological world** we live in.
4. On nine occasions, the use of **the Internet** was discussed. Year 9 and above students at this school all have laptops and Internet access any time on campus. One teacher thought that if students got the opportunity to make their own Web page, it would be great. All of the teachers felt that a website with information on it would be more useful than a CD-ROM with the same information on it, because it can be **updated regularly**. One teacher suggested that customers could pay to receive a logon name and password good for a certain amount of time that would give them access to the information on the page, while another suggested that a free trial period could work well with this logon-based website idea.
5. The use of **CD-ROMS** was discussed three times. Teachers did think that a CD-ROM could be useful as long as it was well developed and carried a very broad range of information about a topic. One respondent felt that CD's were great because one could record demonstrations on them that could not be performed in a classroom setting.

6. Three times, teachers said that they would really find **background material** relevant to CSIRO presentations useful.
7. One teacher said that websites would be very useful as a way of providing **online quizzes** or other assessments.
8. Another teacher felt that computer programs were excellent for **trial-and-error work**.

Summary of 3rd Focus Group

Date: April 16, 2004

Location: CSIRO Science Education Centre, Highett, Victoria

Moderator: Anthony Smith

Recorders: Richard Adams, Sean Doherty

Subject: How can Electronic Media Benefit CSIRO Extension Education Programs?

Start time: 10:05 AM

1. Five times, the respondents brought up that electronic media could be used to deliver **follow-up material** for CSIRO Education programs. Teachers would not only like to have follow-up material for the students, but also information and even teaching plans for themselves. The CSIRO Educators thought that this material could be best delivered on a website.
2. The use of the **World Wide Web** for delivering program materials came up in the discussion eight times. One respondent said that the Internet is good because it caters to different learning styles of different children, and another said that since the Internet is commonly used, it has the advantage of being one of the ways kids are used to seeing information presented. While the current CSIRO Education website is simply a method of promoting the CSIRO Education programs that are available, a website containing topic plans for teachers and material for students, which teachers could subscribe to by paying for a logon name and password, could certainly be useful.
3. The possibility of producing **CD-ROMs** to supplement CSIRO Education programs was discussed four times. One respondent said that because a CD is a concrete object, teachers would probably be more willing to pay for something like that, which they could hold in their hands, rather than something like a website. Another respondent proposed that CSIRO Education might want to make different CDs for different programs, but that approach might not fill up enough space on a CD-ROM. If video recordings were used, they could easily be put on such a CD. A CD could even be used in conjunction with a website by linking to the site right from the CD.
4. The CSIRO Educators brought to our attention several potential disadvantages to using electronic media with their programs. Much of the material in their live, hands-on programs would be extremely difficult to replicate on a screen, and carrying around extra laptops or projectors to do this would also be difficult. Also, it would not be good business for CSIRO Education to put too much of its material or recorded demonstrations on the Web, because teachers

might then be satisfied by simply buying the cheaper Web version of a program without booking actual CSIRO Education demonstrations. In addition, the educators did not think that electronically sending out preparatory material would be helpful because most teachers do not even bother to go over the papers of preparatory material that CSIRO Education currently gives out. Computer availability is also an issue at some schools.

Summary of 4th Focus Group

Date: April 19, 2004

Location: Sacrecoeur Catholic School

Moderator: Sean Doherty

Recorder: Richard Adams

Subject: How can electronic media benefit CSIRO Extension Education Programs?

Start Time: 3:35 PM

1. Eight times the respondents brought up that electronic media would be a helpful way to provide **supplementary material** for CSIRO Education's programs. They stated that it would be helpful if information was provided for the students and lesson plans were provided for the teachers.
2. The **World Wide Web** was brought up 6 times when discussing follow-up material. The teachers felt that it would be helpful (especially for primary teachers) if lesson plans were provided on a website. This was also desired so that students would be able to easily view the material from their homes.
3. Four times the respondents brought up how if the material were **closely related to the curricula then it would be easier to justify purchasing it**. The respondents felt that the school would fund the money for something like a website as long as it is useful and they could justify it. One respondent felt that it would be good if the website projects for the students and provided the answers to the teachers. Another thought that it would be good to separate the provided material by grade level.
4. One of the other comments made was that their school was looking into purchasing data projectors for certain science classes. Another teacher mentioned that CSIRO Education should provide more programs for secondary school students. One teacher said that a CD would be helpful because the Internet does not always work at their school.

Appendix F: Participant Student Questionnaire



Student Questionnaire



By filling out this survey, you can help us to provide more exciting educational programs like the one you just witnessed.

Grade Level: _____

Please answer the following questions by circling your response:
(1 = Not at all, 2 = Not really, 3 = Sort of, 4 = Mostly, 5 = Definitely yes)

- | | |
|--|-----------|
| 1. For you, are computers easy to use? | 1 2 3 4 5 |
| 2. Do you think that the Internet is simple to use? | 1 2 3 4 5 |
| 3. Do you go online often at home? | 1 2 3 4 5 |
| 4. Do you go online often at school? | 1 2 3 4 5 |
| 5. Do you enjoy using the Internet? | 1 2 3 4 5 |
| 6. Would you be interested in completing more activities like the ones you just did? | 1 2 3 4 5 |
| 7. Would you like to be able to see videos related to the program you just did? | 1 2 3 4 5 |
| 8. Would you be interested in learning more about this topic from a Web site? | 1 2 3 4 5 |
| 9. Would you like to be able to discuss this topic with other people online? | 1 2 3 4 5 |

Appendix G: Non-Participant Student Questionnaire



Student Questionnaire



By filling out this survey, you can help us to continue to provide new and exciting educational programs to the children of Victoria.

Please answer the following questions by circling your response:
(1 = Not at all, 2 = Not really, 3 = Sort of, 4 = Mostly, 5 = Definitely yes)

- | | |
|---|-----------|
| 1. For you, are computers easy to use? | 1 2 3 4 5 |
| 2. Do you think that the Internet is simple to use? | 1 2 3 4 5 |
| 3. Do you go online often at home? | 1 2 3 4 5 |
| 4. Do you go online often at school? | 1 2 3 4 5 |
| 5. Do you enjoy using the Internet? | 1 2 3 4 5 |
| 6. Would you be interested in doing some of your class work online? | 1 2 3 4 5 |
| 7. Would you like to be able to see educational videos online? | 1 2 3 4 5 |
| 8. Would you like to learn in school by going to a website? | 1 2 3 4 5 |
| 9. Would you like to be able to discuss schoolwork with your classmates online? | 1 2 3 4 5 |

Appendix H: Phone Protocol for Obtaining Permission to Survey Students

1&2. Hello, my name is _____. I am calling on behalf of the CSIRO Science Education Centre located in Highett, Victoria. I and some other students from Worcester Polytechnic Institute in the U.S.A. are conducting a study for CSIRO assessing student perspectives on the use of the Internet for education.

1. Can I please speak to the head of the science department?
2. We were wondering if you could help us by letting your students fill out a survey.

WAIT FOR ANSWER. IF TEACHER AGREES, PROCEED.

We have several ways of getting the survey to you. We can fax it to you, we can email it to you, or we can mail it to you with a postage-paid return envelope. Which is best for you?

COLLECT INFORMATION APPROPRIATE FOR METHOD

Appendix I: Transcripts of Interviews with Electronic Media Vendors

Transcript of Interview with Robert Dark of Web Genius Development

Date: April 20, 2004

Location: Phone Interview

Interviewer: Sean Doherty

Subject: What are the costs associated with making an educational website?

Start time: 10:00 AM

Sean started the interview by introducing himself and describing our project, saying that we are doing a research project for CSIRO Education regarding incorporating electronic media into CSIRO Education programs.

He then started off by describing that CSIRO Education wants a basic site for each of their programs that would be easily expandable to include videos and animations and they also need to be able to have teachers log on and off to the site. Sean then asked a few questions:

Sean: Can you give me a ballpark figure as to how much a website like I described would cost to implement?

Mr. Dark: It is hard to give an exact figure because many factors come into play as to how much the development of a website will cost. We would have to sit down and discuss exactly you want before I can give you an exact number. I can say that it would run between \$3,500 and \$4,500 depending on complexities.

Sean: What are these complexities, and which ones cost more than others?

Mr. Dark: Things such as interactions with a database make a website more expensive. There are different levels to this interaction, with a simple group of login names being one of the cheapest to things such as a lost password utility and a user administrator being more expensive. Things like allowing individual users to upload to the website and creating a bulletin board are probably the most expensive.

Sean: What about things such as flash animations, or interactive programs?

Mr. Dark: These are very difficult to give a figure on, because they depend so much on how complex the animation is. If it is a 5 second clip, it wouldn't be that expensive, but something comparing to an interactive program would be much more expensive. It really depends on how long it takes to develop.

Sean: If CSIRO Education were to produce the flash animations after the design of the website, would these animations be difficult to add to the created website?

Mr. Dark: Not at all, it would be a simple procedure. The main cost in a program as you have described is in the development. All other costs would be more or less negligible. Flash technology is good for websites because 98% of the market can use these files and allows for a majority of customers to see the animations.

Sean: What about streaming video? Is that something that costs a lot to put on a website?

Mr. Dark: Again, as with the flash technologies, the costs involved with streaming video are mainly tied to the development of the media, rather than the costs of putting it online. Since CSIRO already has a hosting service, the costs of bandwidth probably wouldn't be as big an issue as it is with other companies. These videos and animations are really helpful for e-learning technologies, which it sounds like CSIRO Education is looking for.

Sean: Can you go more in depth with e-learning? What are the costs involved and are some things more expensive than others?

Mr. Dark: E-learning is a new field that is getting a lot bigger and more involved. Things such as online tests and assessments are a growing business for us and something whose costs also depend on complexity. Simple uses such as an online quiz whose results are sent to a teacher via email are relatively inexpensive, while assessments integrated with a database to track answers or to possibly change the quiz depending on the student are more expensive. All of these things would push the estimate I gave you earlier into the higher range, and once again I can't give you a final price without first knowing exactly what you want.

Sean: Would the source code be included in with the package so CSIRO Education can make changes later?

Mr. Dark: We deliver the site with all its source code so that if you want to maintain the site you are able to. We also can maintain it for a minimal price compared with producing it.

Sean then thanked Mr. Dark and ended the interview at 10:30am

Transcript of Interview with Chris Keenan of Create-it Web Development

Date: April 20, 2004

Location: Phone Interview

Interviewer: Sean Doherty

Subject: What are the costs associated with making an educational website?

Start time: 10:35 AM

Sean started the interview by introducing himself and describing our project, saying that we are doing a research project for CSIRO Education regarding incorporating electronic media into CSIRO Education programs.

He then started off by describing that CSIRO Education wants a basic site for each of their programs that would be easily expandable to include videos and animations and they also need to be able to have teachers log on and off to the site. Sean then asked a few questions:

Sean: Can you give me a ballpark figure as to how much a website like I described would cost to implement?

Mr. Keenan: If you are looking for an educational website that is easily updateable, I would propose using something similar to a current project of ours that uses a content management system. This is a system in which users, namely (CSIRO Education) employees would be able to log on to the site and easily change the content. Let me send you a link to see an example.

Mr. Keenan then sent a link to a demo of this content management system on their website. Sean opened it and continued with the interview.

Sean: What are the benefits of this system?

Mr. Keenan: Like I said earlier, it is easily updateable by people who need no website development experience. It uses a web interface to edit the content on the site and allows for easy uploading of documents and things such as animations and videos. It comes with the ability to set up a "chain of command" to editing the site so that managers would have final say before something is finally put online. It keeps a history of changes so that if something goes wrong, an older version of the site could be reverted to. It also highlights changes to the site and lets people know when new material is put online. All menus and navigational links are automatically made by the system so it requires almost no maintenance other than adding the information to the site. A bulletin board system will also be integrated into the system later on this year.

Sean: Can teachers log on to a special part of a site to see extra information?

Mr. Keenan: The system comes with the ability to have 10 super users (people who can edit the site, and control the abilities of users) and up to 150 regular users who can log on to the site and see whatever sites the super users give them permission to see. These 150 accounts can be deleted or changed at any time, allowing for expiring passwords as you described earlier.

Sean: So how much would a system like this cost?

Mr. Keenan: The base license for the content management system must be purchased through an American company named Ektron. They charge \$11,000-\$12,000 for the license including the ability to have the users as we previously mentioned. They do have discounts for educational companies, but I would have to get back to you as to how much exactly those discounts are.

Sean: What other costs would be involved?

Mr. Keenan: All CSIRO Education would need is a set of design templates and styles for the content management system to run behind. These designs can be made different for each page or you could just have one over-arching design. Of course, the more templates you have, the higher the development costs.

Sean: So what exactly would these templates and such cost?

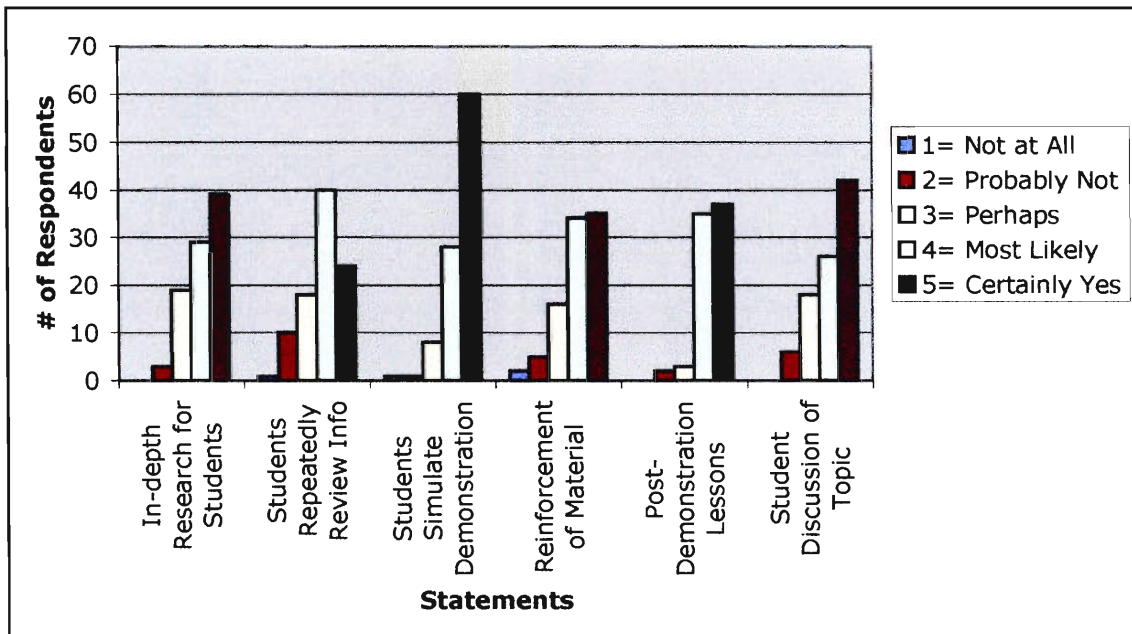
Mr. Keenan: We would charge around \$8,000 for the development of these templates, which would include a year of maintenance to the site as well as updates to the Ektron system for a year.

Sean then thanked Mr. Dark and reminded him about getting the information about the educational discount. The interview ended at 11:00am

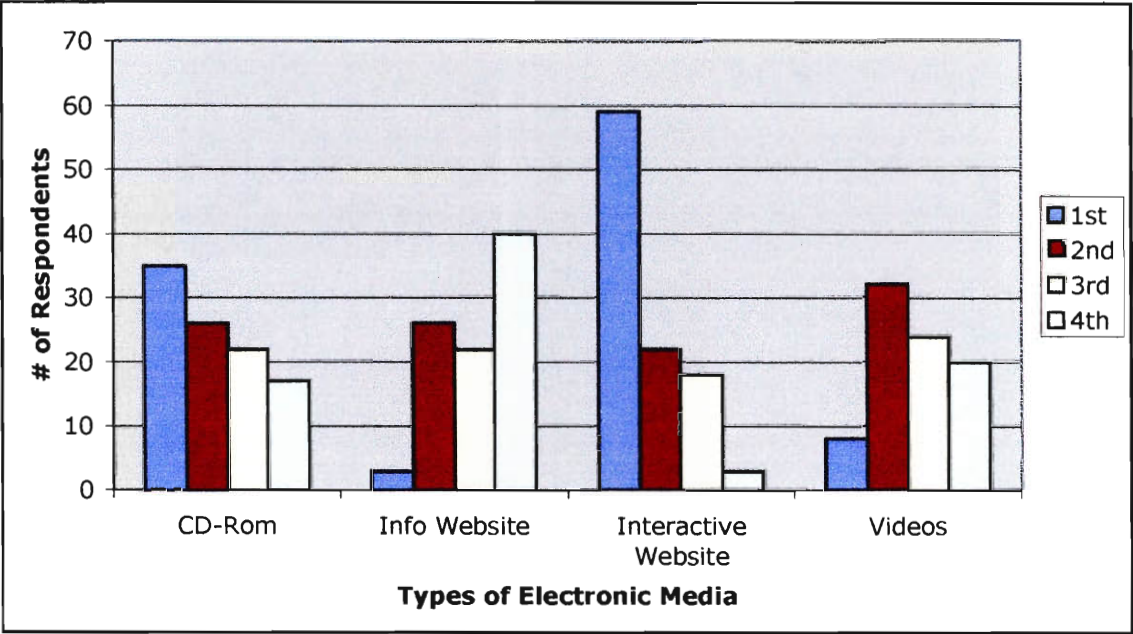
Appendix J: Results of All Questions on Teacher Survey

This appendix will summarize the results of the teacher survey. It is broken down into 6 sections: overall results, participant and non-participant results, and Catholic, Independent and Government results. Each graph shows the statements posed to teachers on the x-axis and the number of participants on the y-axis. The legends show what corresponds to each response in the graphs and the captions are the question as it was posed to teachers on the questionnaire. A complete copy of the questionnaire can be found in Appendix B.

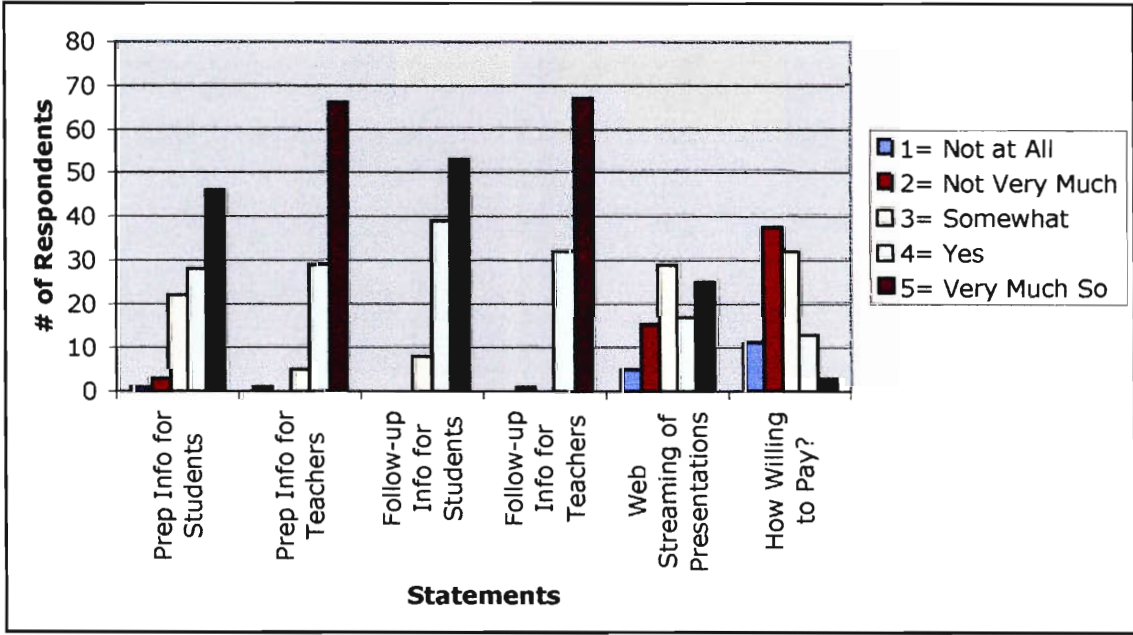
Overall Results



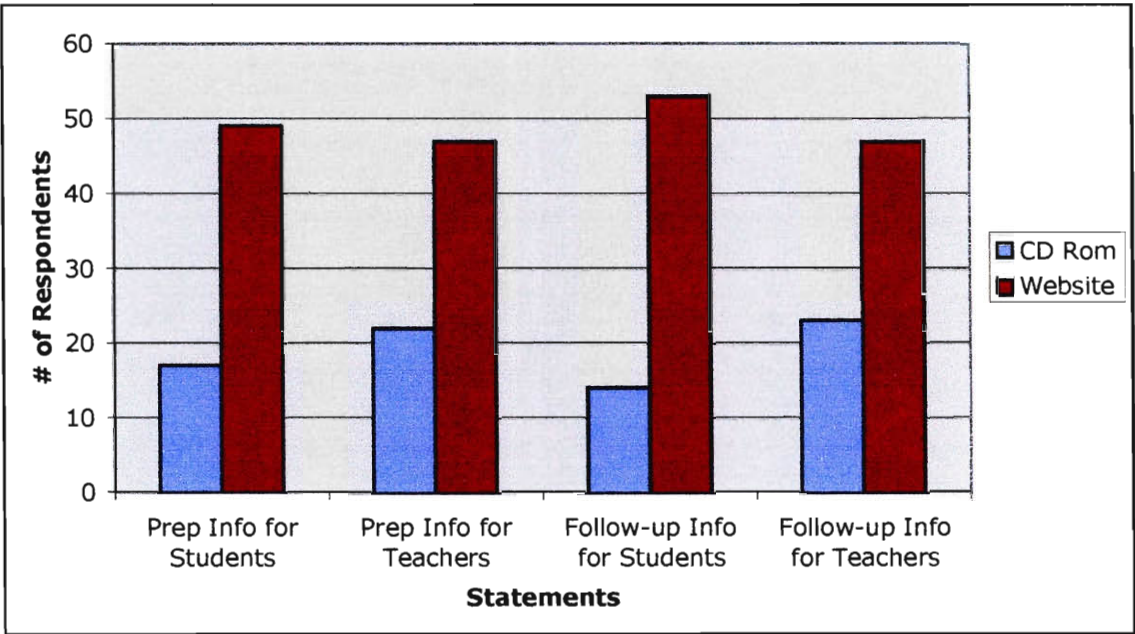
Do you feel the following items would make CSIRO's programs more appealing?



Please rank the following types of electronic media in order of what would be helpful to you by placing a number in front of the item.

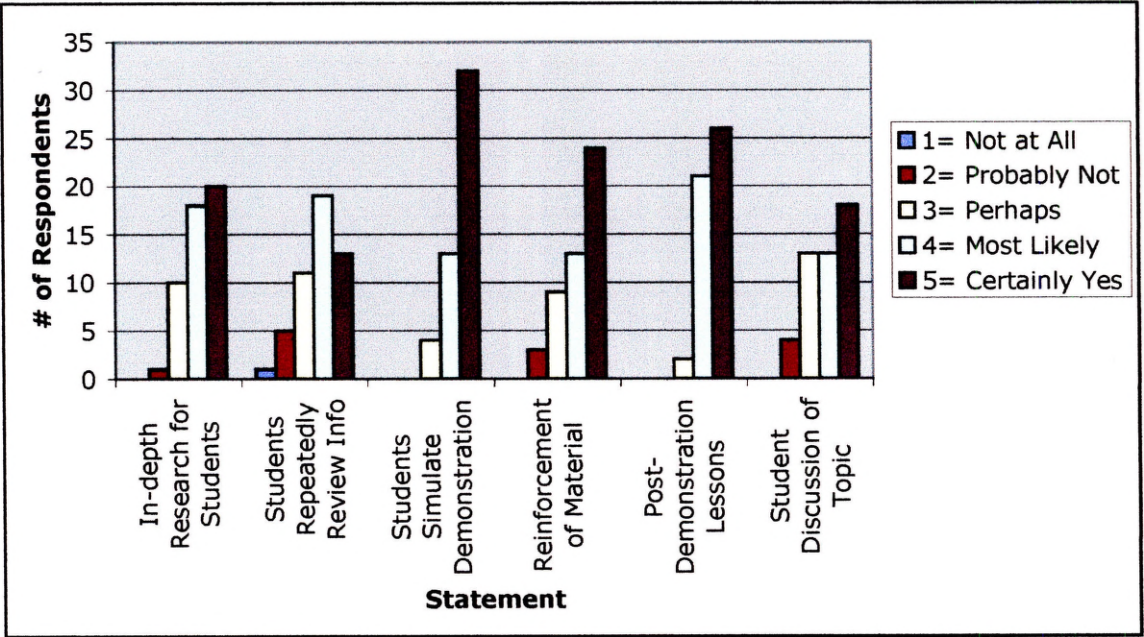


Would any of the following additional materials for a CSIRO program appeal to you?

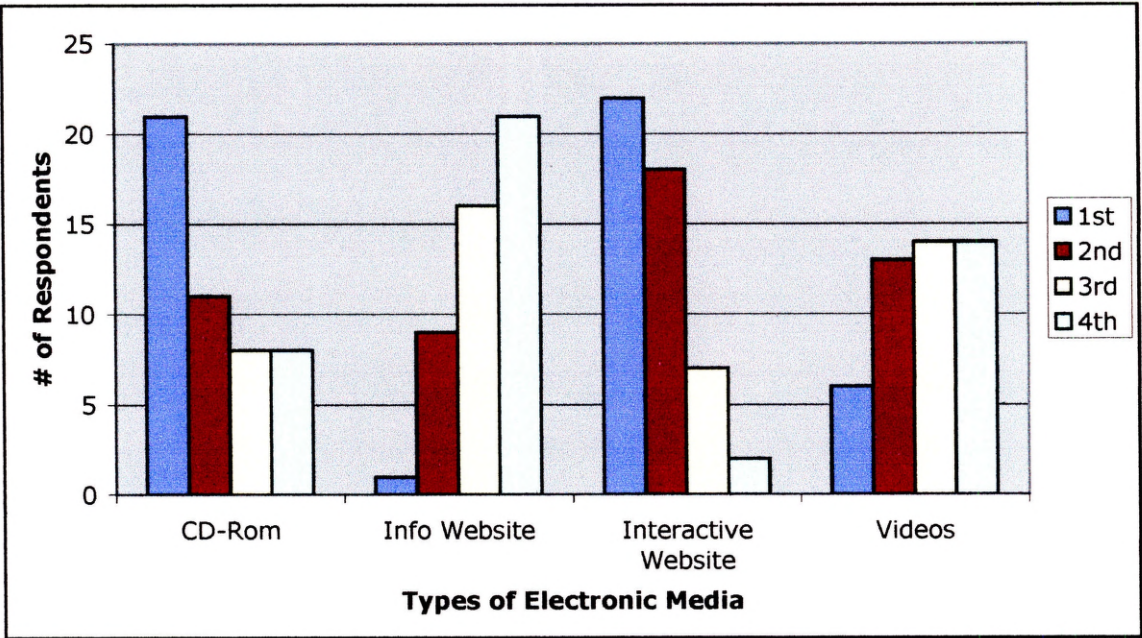


For each type of additional material, please circle the format that would be most useful to you (CD-ROM or Website)

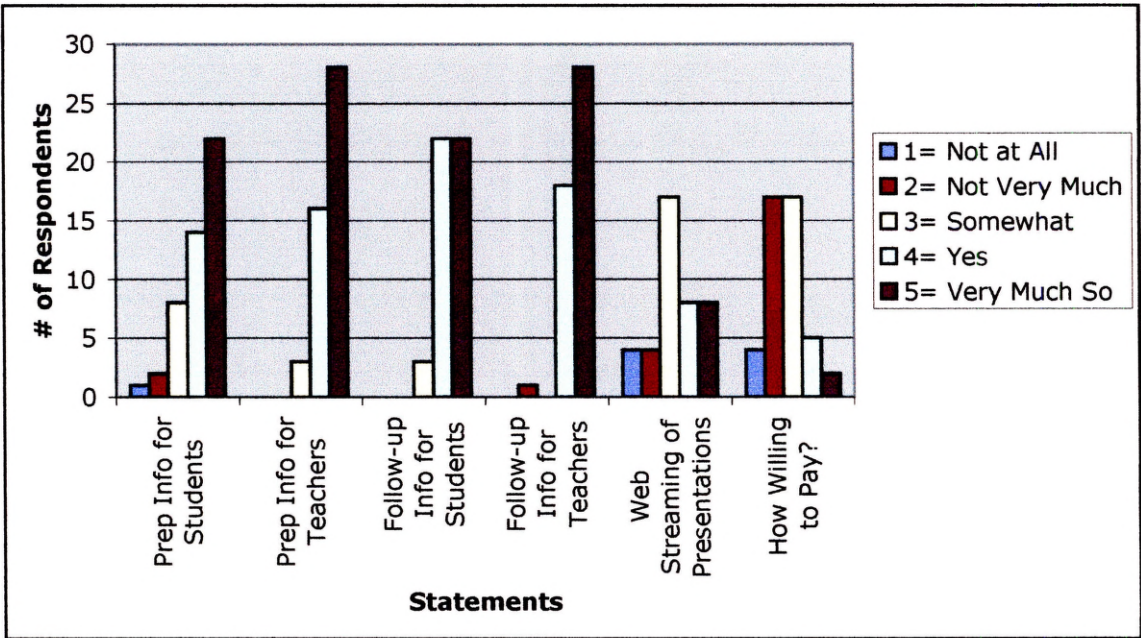
Non-Participant Results



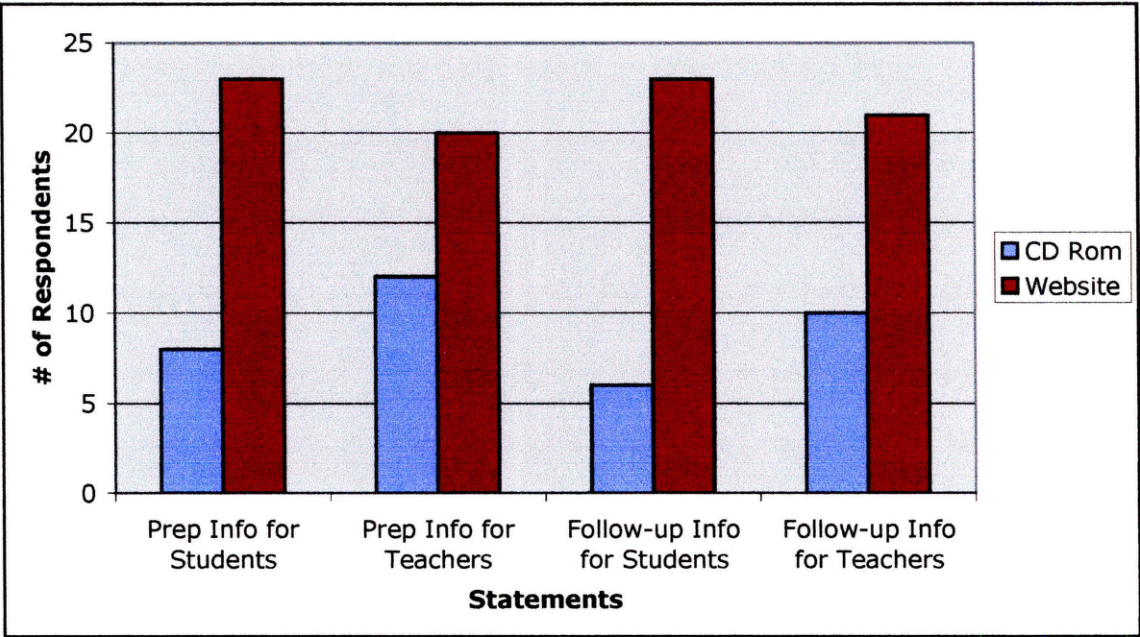
Do you feel the following items would make CSIRO’s programs more appealing?



Please rank the following types of electronic media in order of what would be helpful to you by placing a number in front of the item.

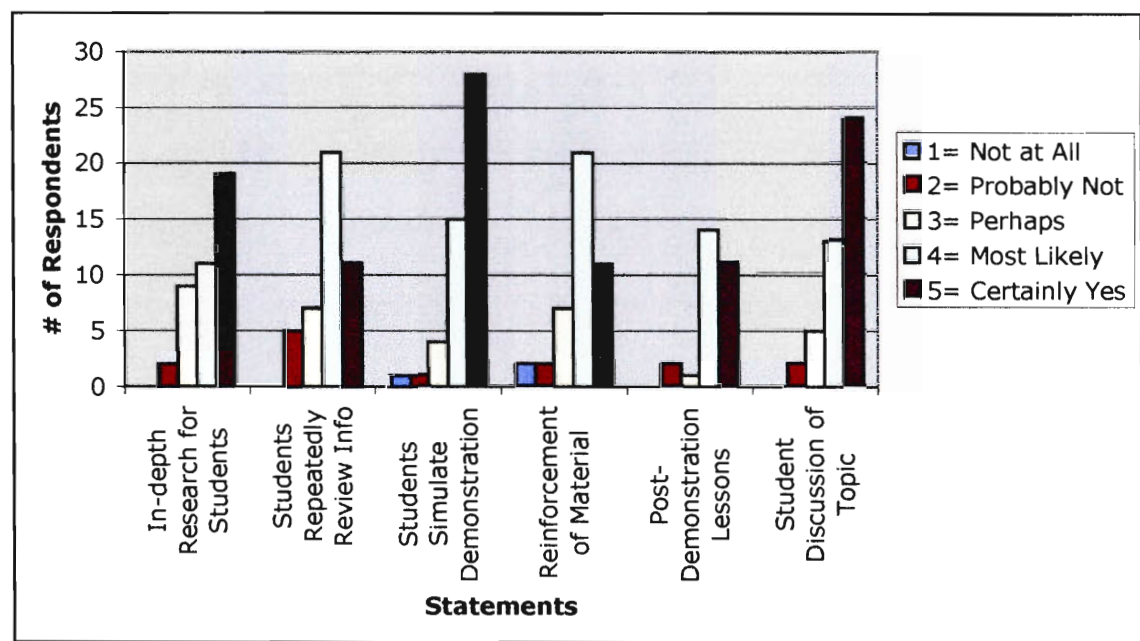


Would any of the following additional materials for a CSIRO program appeal to you?

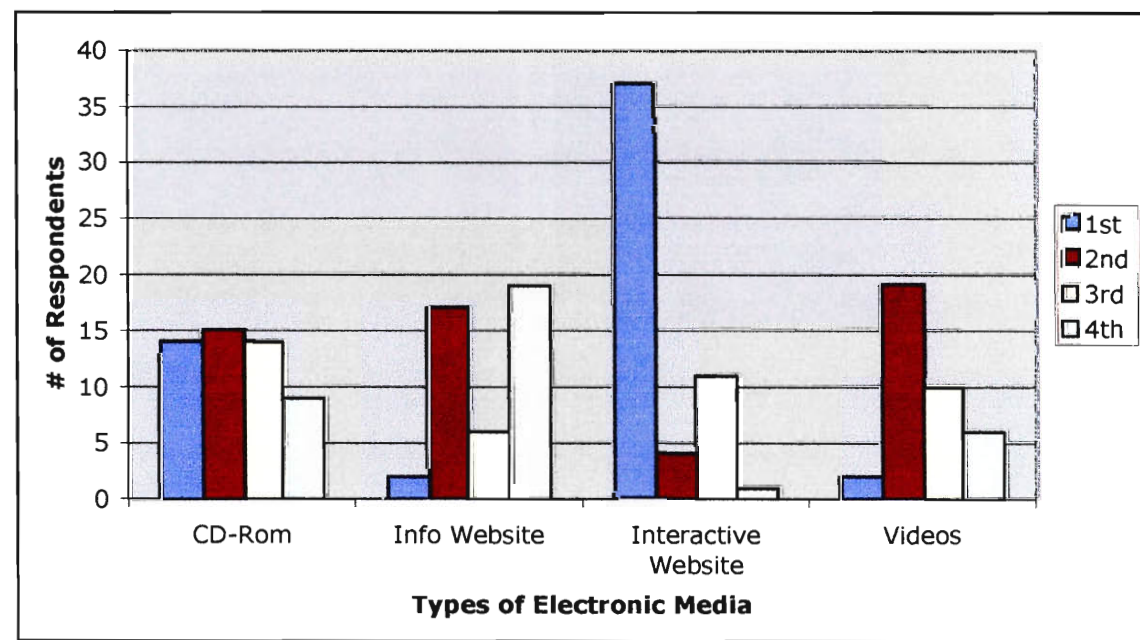


For each type of additional material, please circle the format that would be most useful to you (CD-ROM or Website)

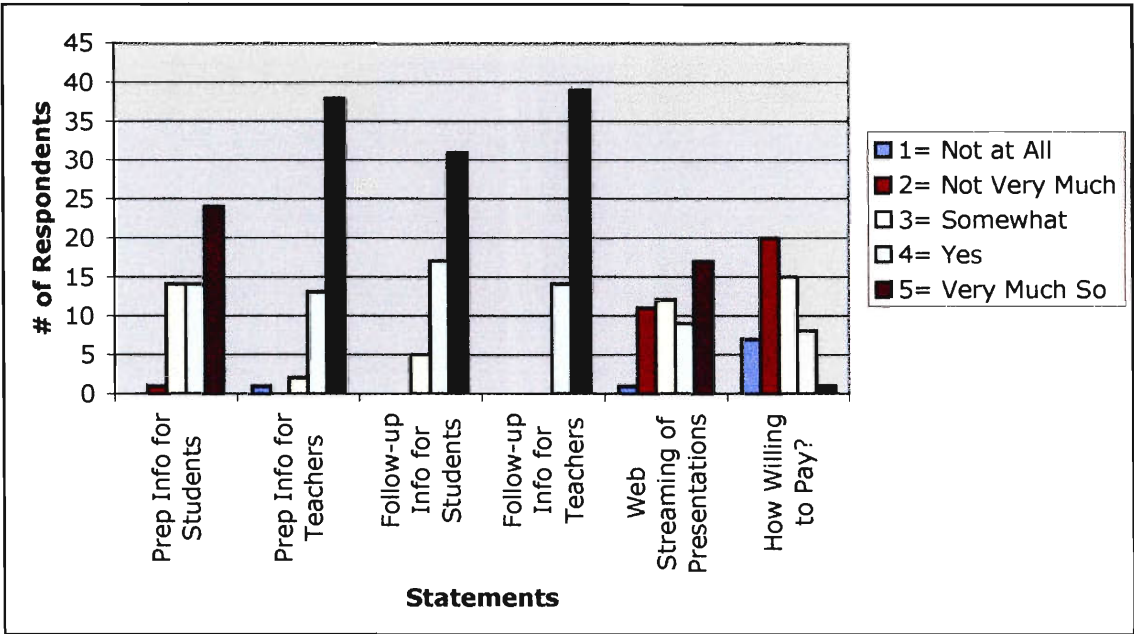
Participant Results



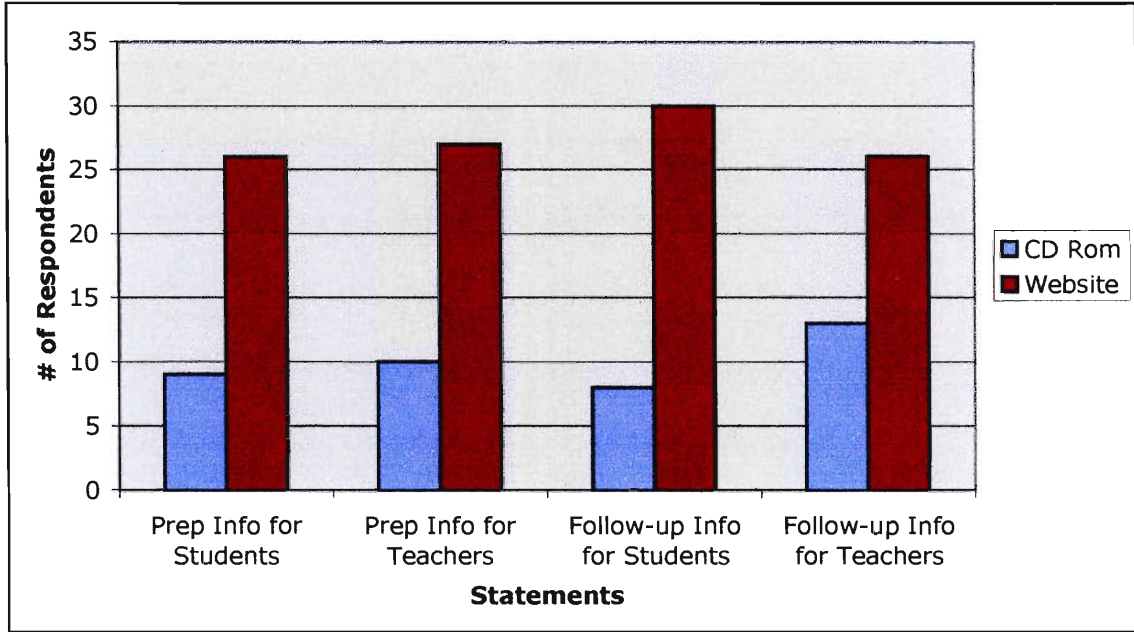
Do you feel the following items would make CSIRO's programs more appealing?



Please rank the following types of electronic media in order of what would be helpful to you by placing a number in front of the item.

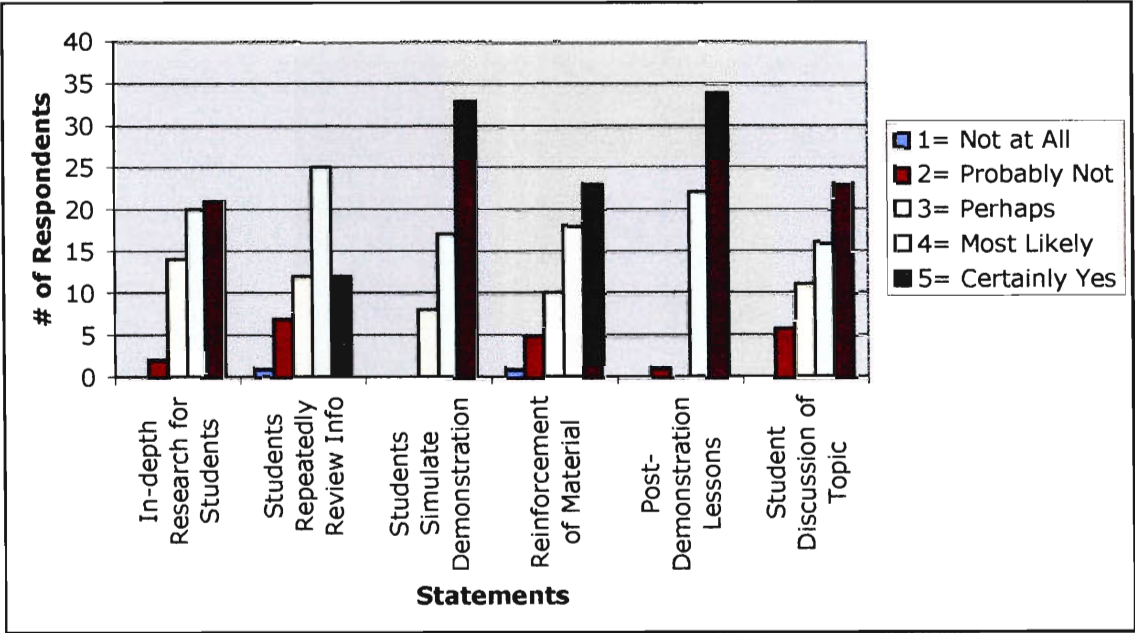


Would any of the following additional materials for a CSIRO program appeal to you?

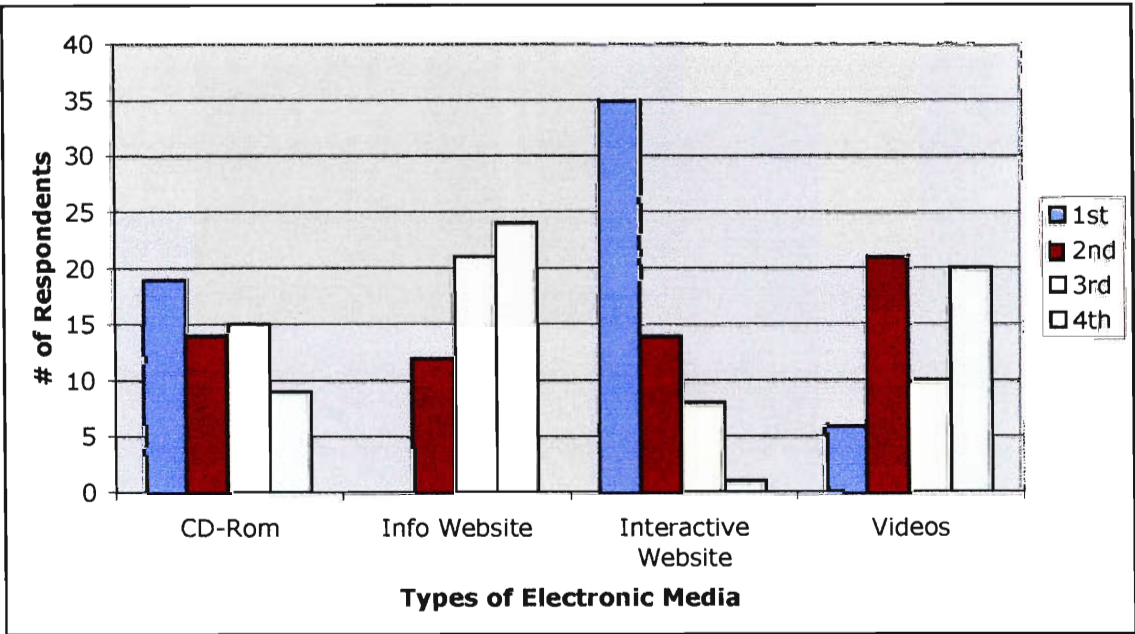


For each type of additional material, please circle the format that would be most useful to you (CD-ROM or Website)

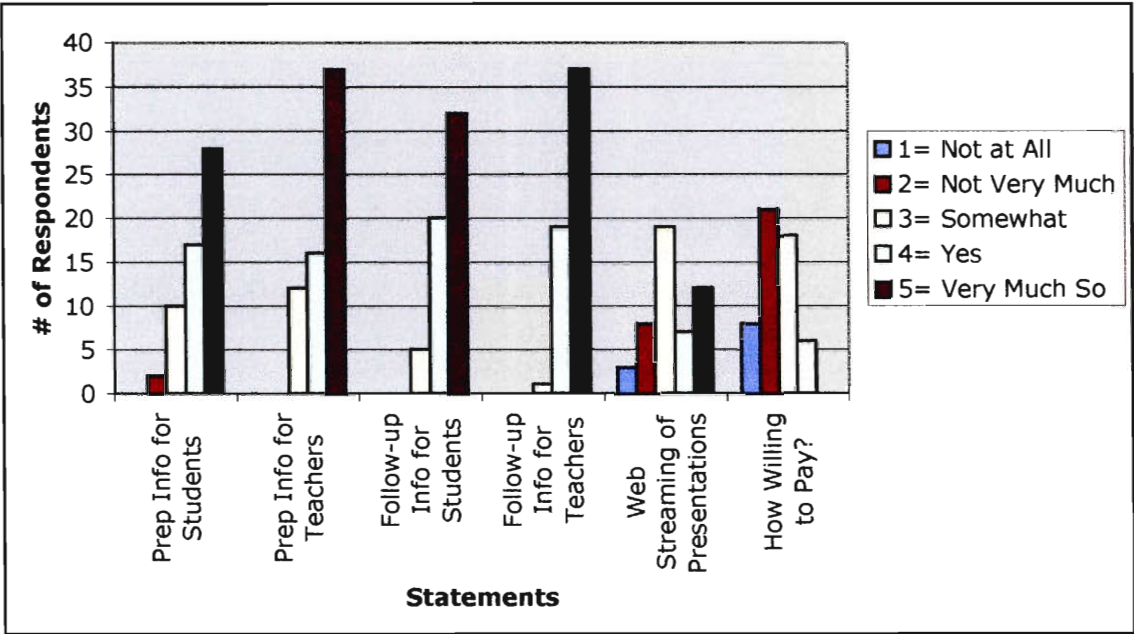
Government School Results



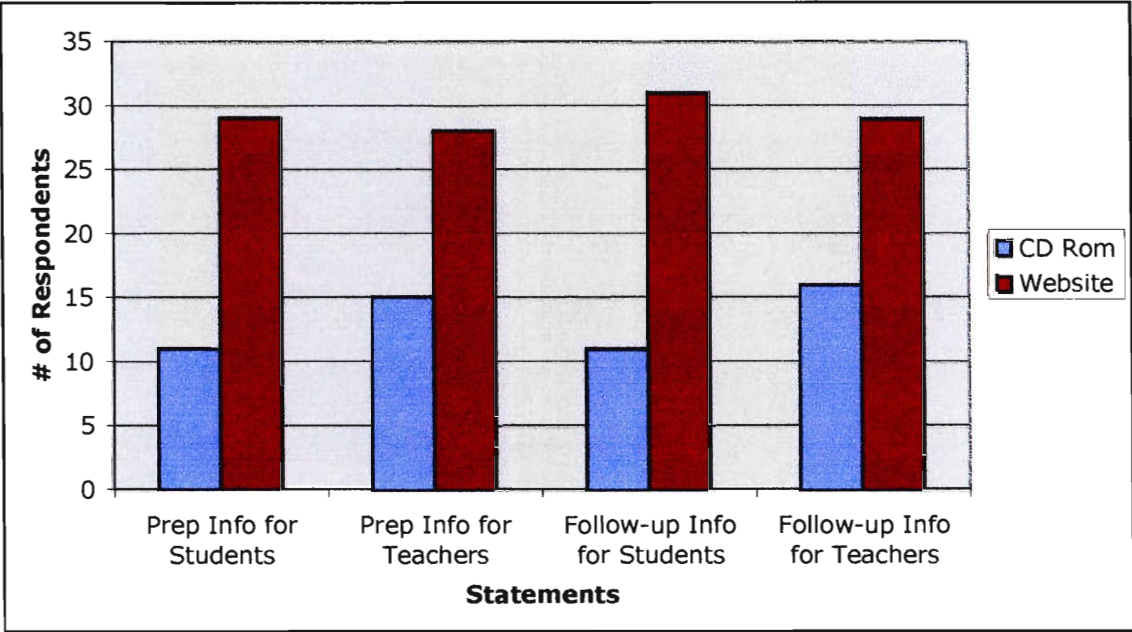
Do you feel the following items would make CSIRO’s programs more appealing?



Please rank the following types of electronic media in order of what would be helpful to you by placing a number in front of the item.

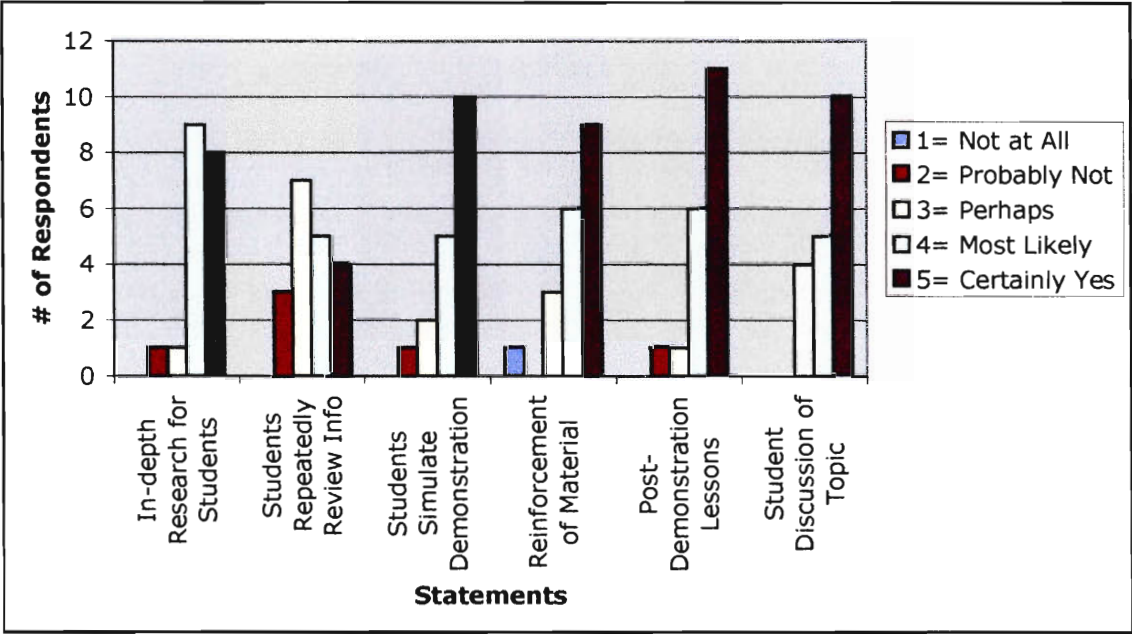


Would any of the following additional materials for a CSIRO program appeal to you?

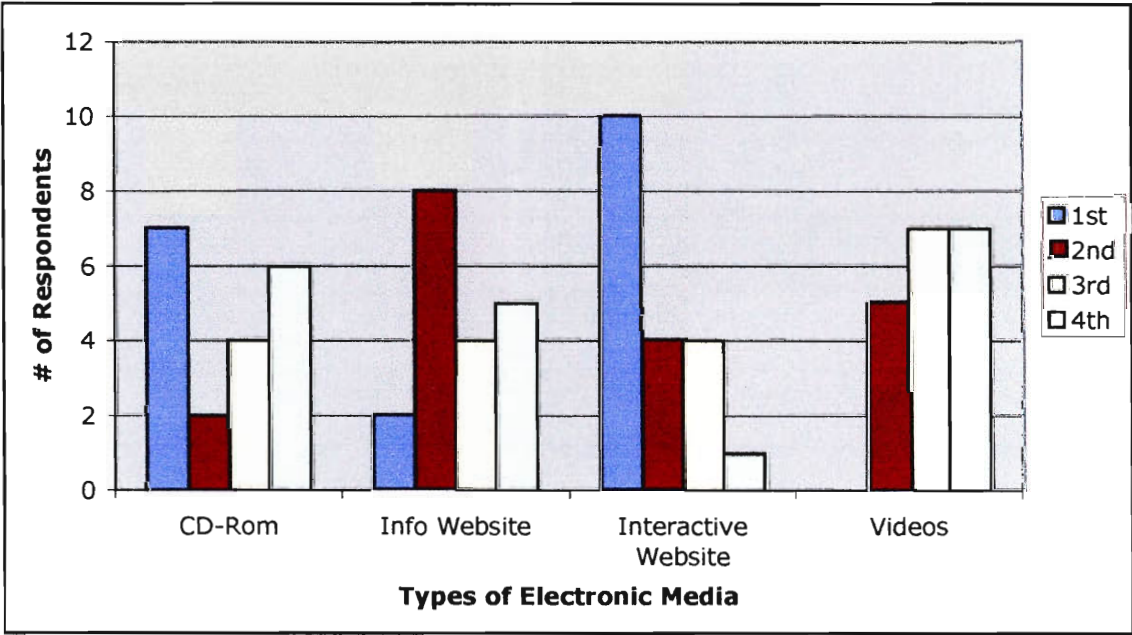


For each type of additional material, please circle the format that would be most useful to you (CD-ROM or Website)

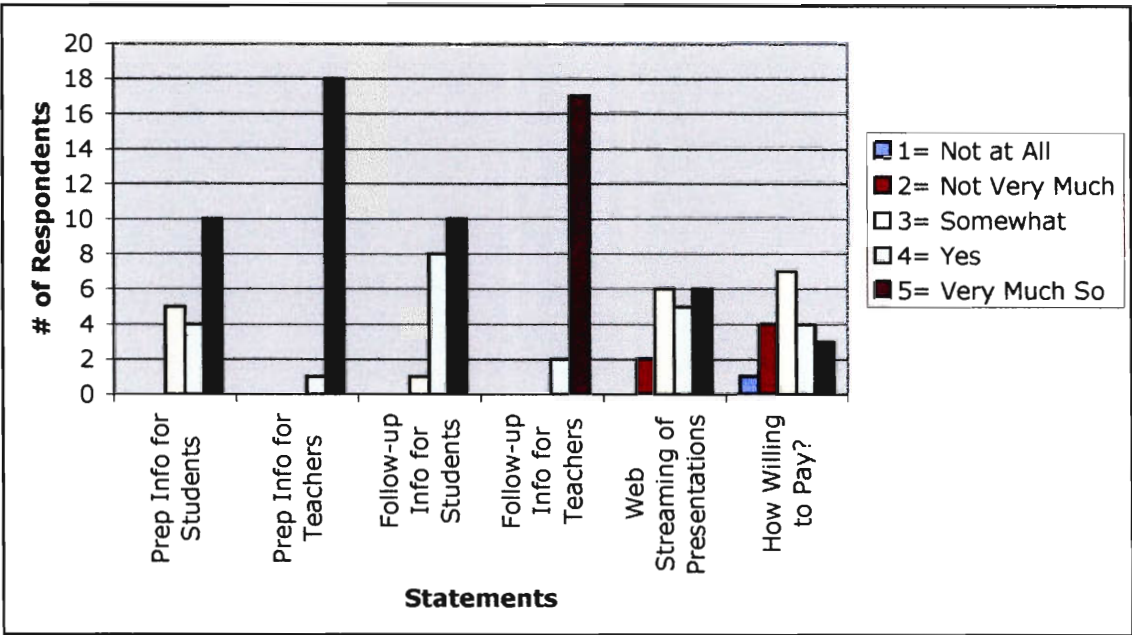
Catholic School Results



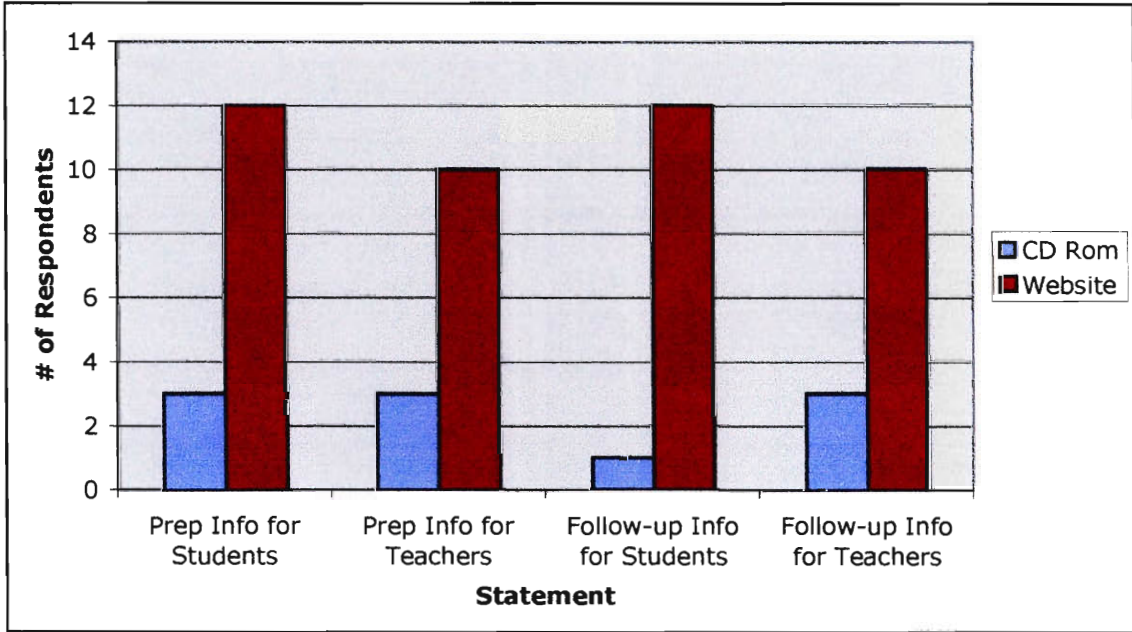
Do you feel the following items would make CSIRO's programs more appealing?



Please rank the following types of electronic media in order of what would be helpful to you by placing a number in front of the item.

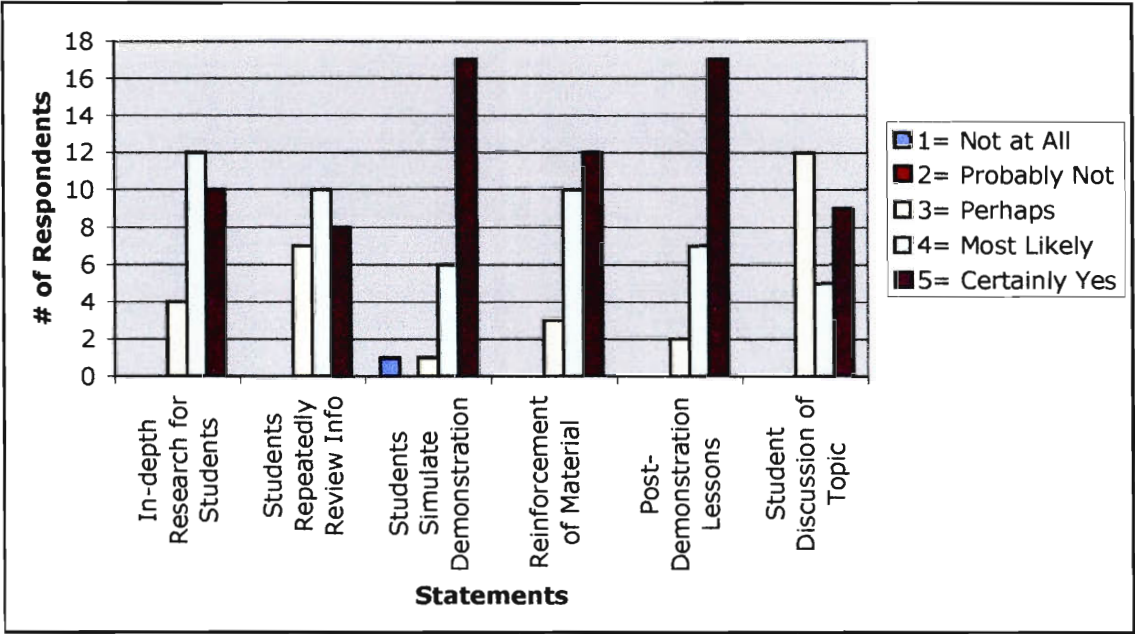


Would any of the following additional materials for a CSIRO program appeal to you?

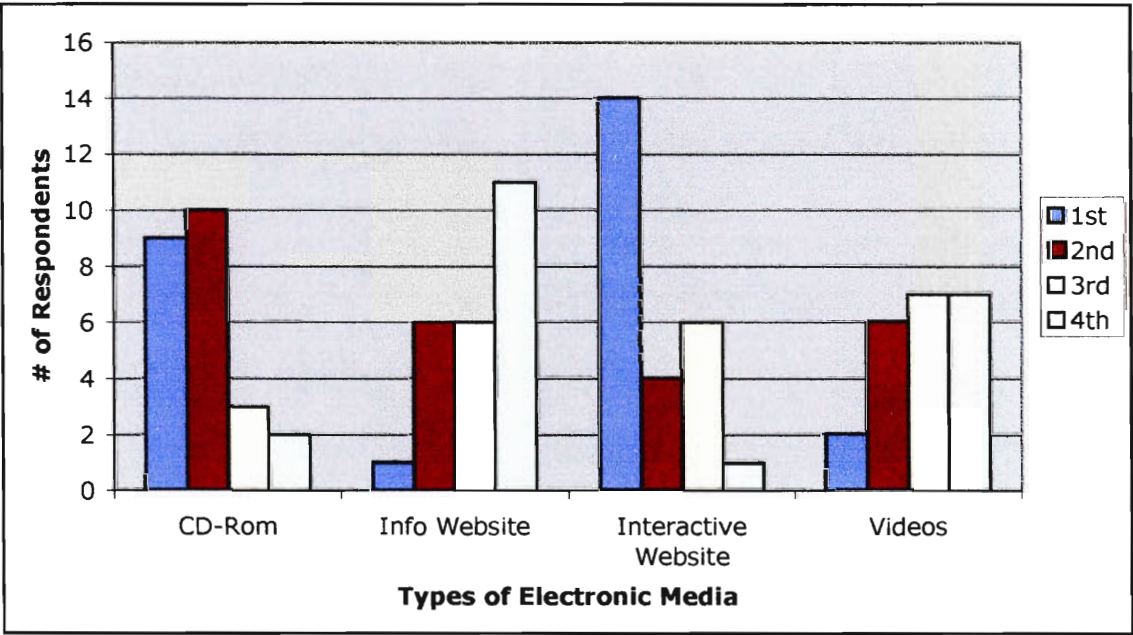


For each type of additional material, please circle the format that would be most useful to you (CD-ROM or Website)

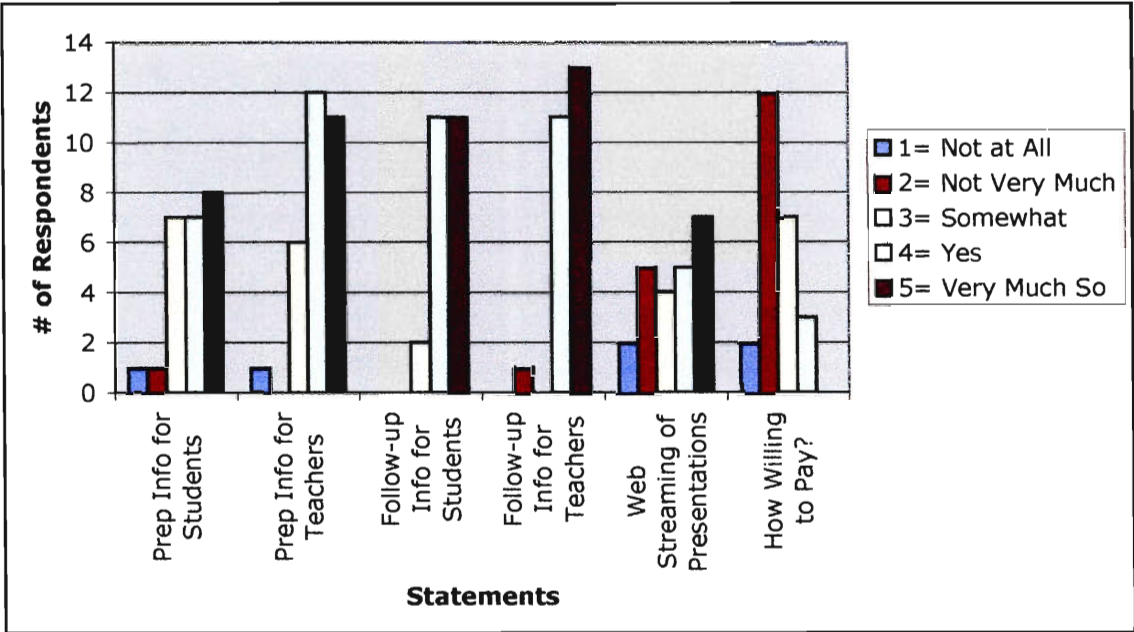
Independent School Results



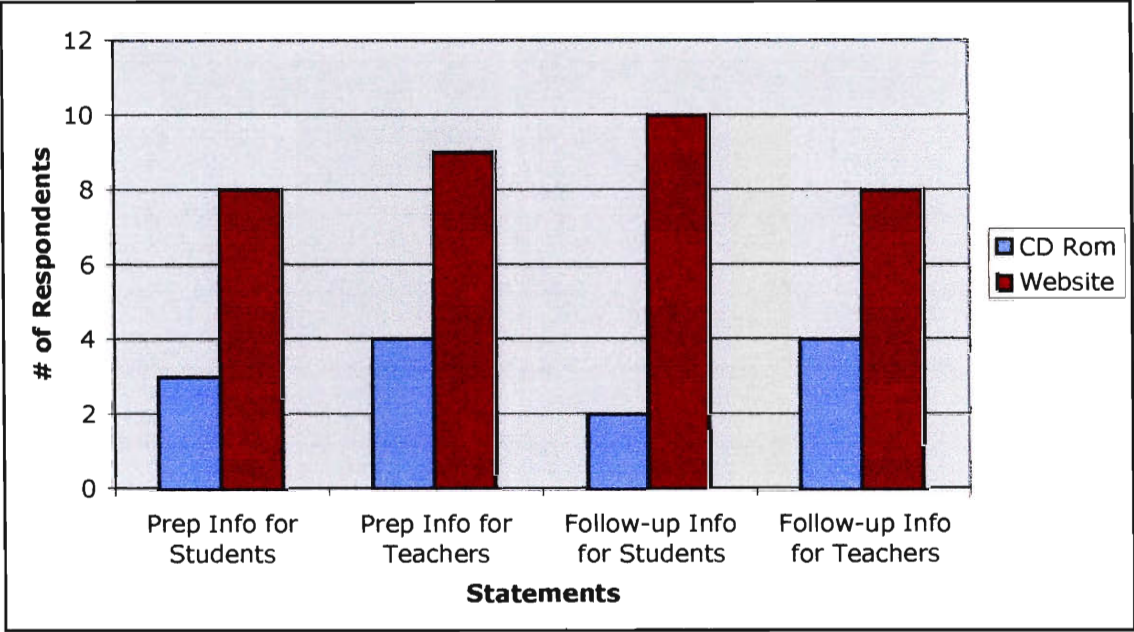
Do you feel the following items would make CSIRO’s programs more appealing?



Please rank the following types of electronic media in order of what would be helpful to you by placing a number in front of the item.



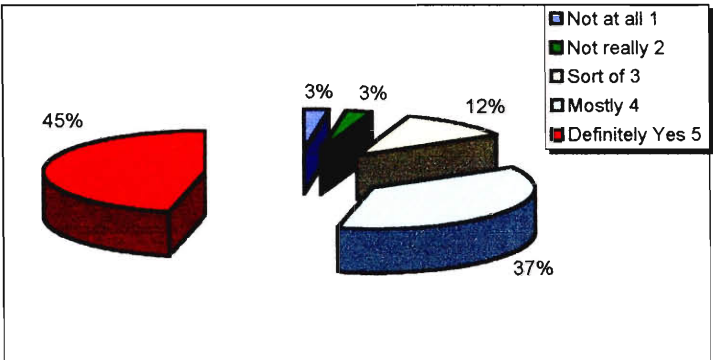
Would any of the following additional materials for a CSIRO program appeal to you?



For each type of additional material, please circle the format that would be most useful to you (CD-ROM or Website)

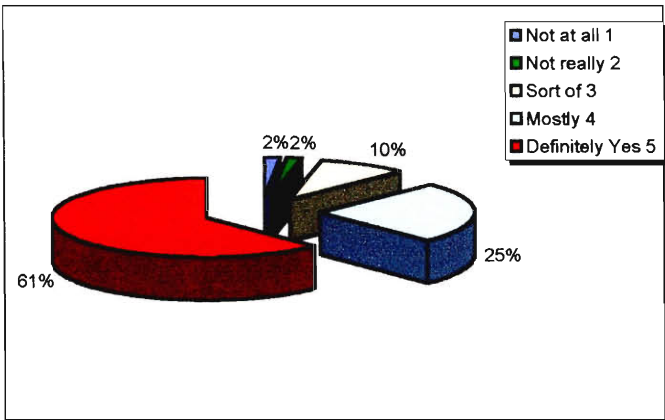
Appendix K: Results of All Questions on Student Survey

Students that have participated in a CSIRO Education program



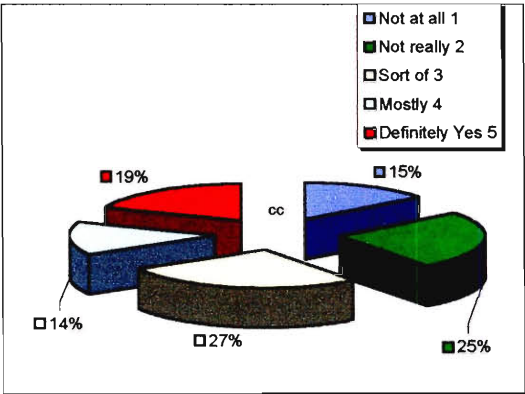
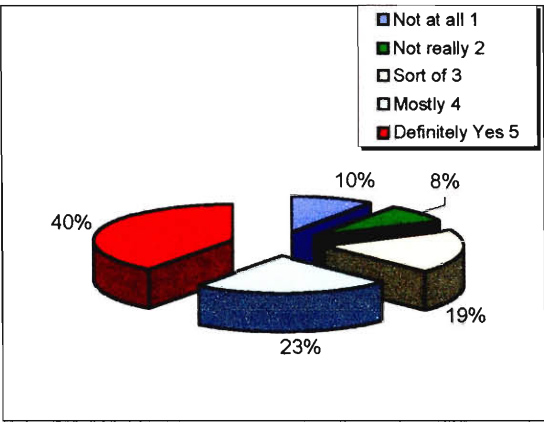
1. For you, are computers easy to use?

Question one dealt with how easy it was for students to use computers. As one can see from the pie chart above, 82% of the students answered this question with a “Mostly” or “Definitely Yes” response. This suggests that most kids find it easy to use computers and that it would not be a problem for the students if electronic media were implemented into CSIRO’s Education’s programs.



2. Do you think that the Internet is easy to use?

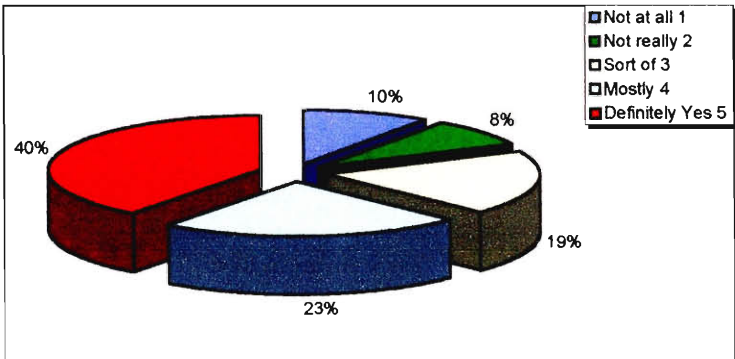
Question two dealt with whether or not the Internet was easy to use. As one can see in the graph above, the students responded with over 85% of them circling either “Mostly” or “Definitely Yes”. This suggests that it would be easy for the students if CSIRO Education were to implement electronic media in the form of a Web site.



3. Do you go online often at home?

4. Do you go online often at school?

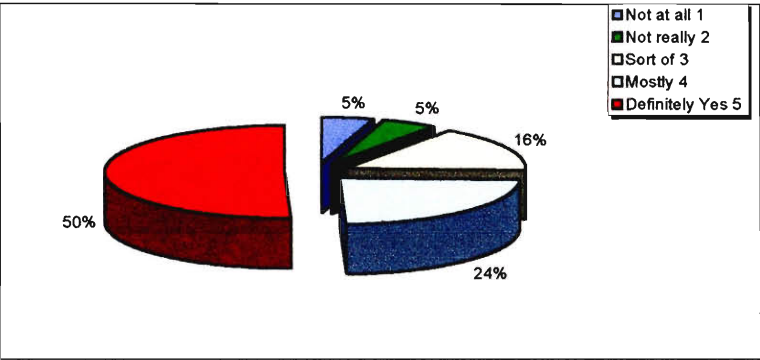
Questions 3 and 4 were related to how often a student goes online at school and at their house. 63% of the students answered either “Mostly” or “Definitely Yes” to question 3. However, when the same students answered question 4, which dealt with how often a student goes online at school, only 23% of them answered either “Mostly” or “Definitely Yes”. These results can be seen in the above graph. This might suggest be that the students are not able to easily access the Internet when at school due to various reasons. If CSIRO Education does supplement its programs with electronic media, it may want to create activities that the students can view at home.



5: Do you enjoy the Internet?

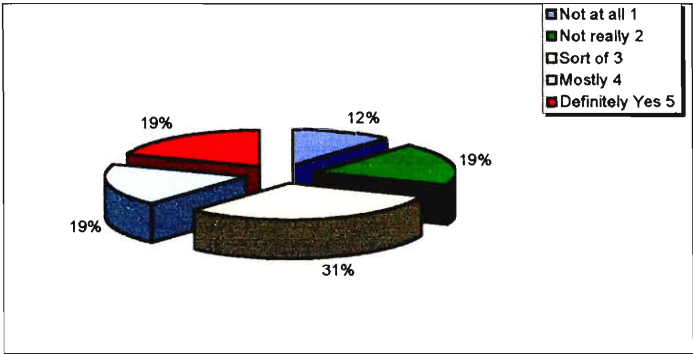
The fifth question asked the students if they enjoyed using the Internet. For this question 40% of the students circled “Definitely Yes” for their response and an additional 23% of the students circled “Mostly”. Although the Internet may not always be available for all students, their responses to this question suggest that the majority of students enjoy using it.

The next 4 questions on the questionnaire dealt with the students’ opinions about learning on the Internet.



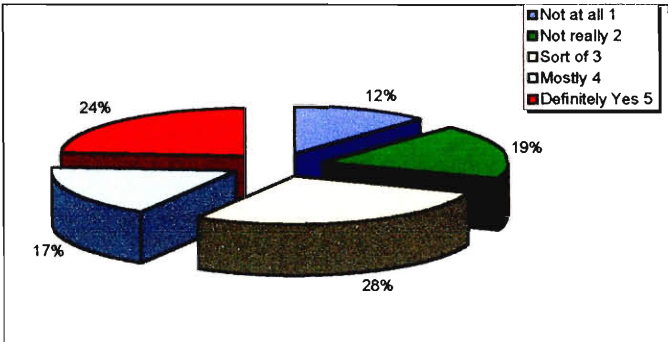
6. Would you be interested in completing more activities like the one you just did?

Question 6 specifically asked if the students were interested in participating in another activity like the one they just did. Close to 75% of the students either answered “Definitely Yes” or “Mostly”. This suggests that the education programs offered by CSIRO Education are interesting to the students. These results can be seen in the graph above.



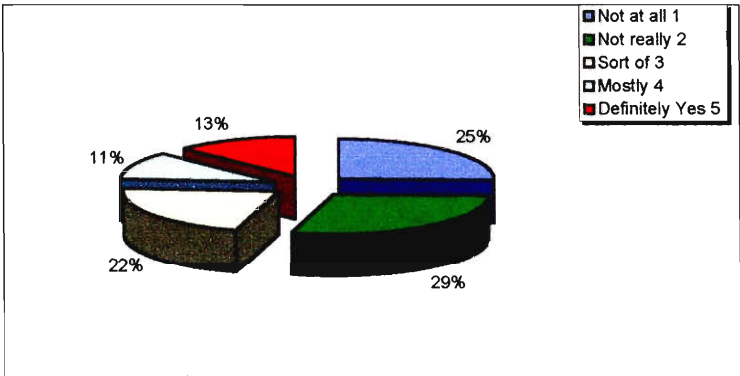
7. Would you like to be able to see videos related to the program that you just did?

When the students were asked this question about a third of the students circled “Sort of,” and the other two thirds were evenly spread throughout the other 4 choices with no major peaks in the graph. The graph above displays a representation of this showing the students’ responses for each choice. This suggests that in general the students are not overly interested in viewing videos related to CSIRO Education programs.



8. Would you be interested in learning more about this topic from a Web site?

The second to last question dealt with students’ interest in learning new material on the web. As in the results to the previous question, there were no real peaks in the graph but rather the responses were more evenly spread out among the choices. Similar to the last question no genuine suggestion can be made about these data except that the students are not extremely excited to learn new information on the Internet. This can be seen in the pie chart above.



9. Would you like to be able to discuss this topic with other people online?

The last question on the questionnaire asked if they would enjoy talking to other students and teachers about the subject online. As one can see in the pie chart above this was the only question where the majority of the responses were “Not at All” and “Not really”. 54% of the students answered the question this way, which may suggest that the students are not interested in an online discussion of the education programs.

Break Down of CSIRO Education Programs

Fifth and Sixth Grade Energy and Its Uses

There were a total of 58 fifth and sixth graders who have participated in the education programs and filled out the questionnaire. The chart below shows the opinions of these students for each question on the questionnaire.

	Not at all	Not really	Sort of	Mostly	Definitely yes
Computers easy to use	2	2	14	19	21
Internet easy to use	1	4	12	18	23
Online at Home	11	10	9	11	17
Online at School	5	6	16	12	19
Enjoy the Internet	3	2	2	3	48
Class work online	0	2	8	7	41
Videos online	2	7	10	15	24
Learn with a website	0	2	13	13	30
Discuss work online	7	8	14	10	19

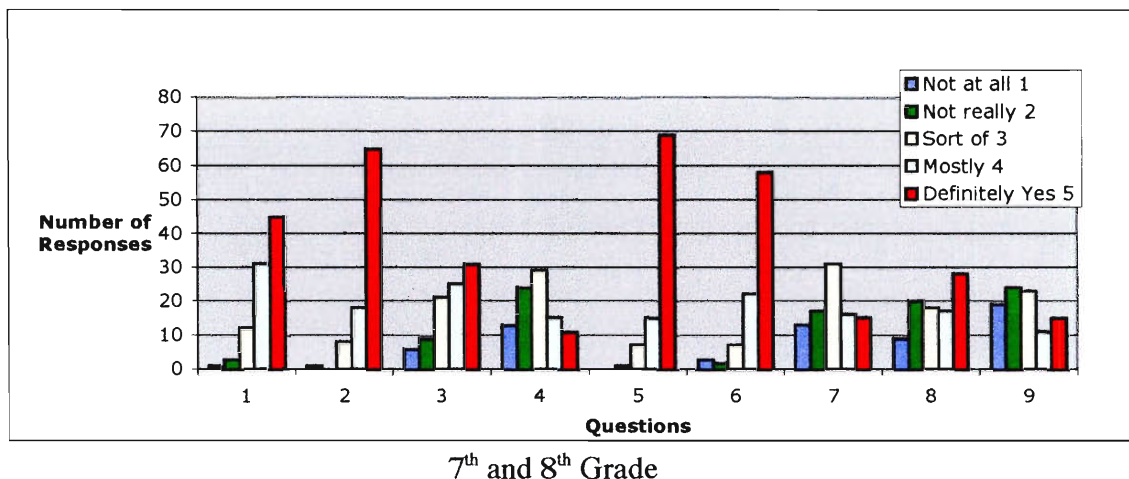
5th and 6th Grade

From analyzing the responses listed in the chart above we can suggest that 5th and 6th grade students find it easy to use computers and the Internet. These students go online at home and at school in relatively similar proportions. As one can see from questions 3 and 4, 28 of the students answered “Mostly” or “Definitely Yes” for going online often at home and 31 circling the same responses for going online often at school. Nearly all of them enjoy using the Internet with 48 of the 58 responses being “Definitely Yes” to question number 5.

The last four questions on the questionnaire dealt with the specific CSIRO Education program that the students participated in. The children also appear to enjoy CSIRO Education’s programs since 41 of them answered “Definitely Yes” to question 6. The seventh question dealt with the desire to view videos on the topic of the education program. For this question, 39 of the children circled “Mostly” or “Definitely Yes”, which may suggest that the students are interested in viewing videos related to the education programs. Questions 8 and 9 asked if the students would like to learn more about the subject from a website and if they would like to discuss the topic online with fellow students and teachers. As far as learning from a website, 33 of the students circled “Mostly” or “Definitely Yes”, which leads us to suggest that they would like more information to be provided on a website. Exactly half the students would like to be able to discuss the education program online with other students and teachers. The last four questions answered by the 5th and 6th graders suggest that the students like the education program offered by CSIRO Education and that the students would enjoy having more information about the subject.

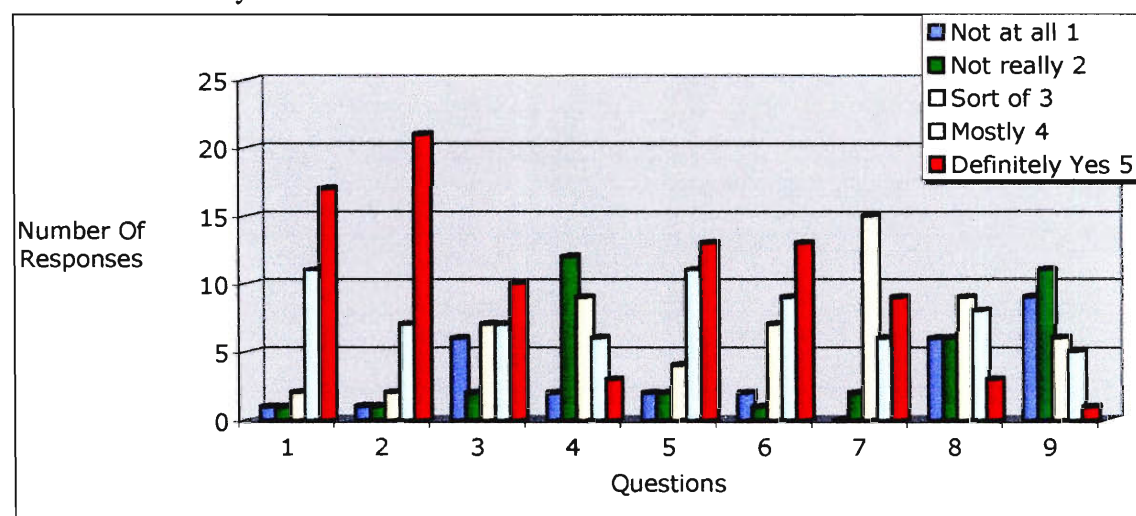
Seventh & Eighth Grade Cool Chemical Science

The graph below represents the percentage of 7th and 8th grade student responses to each of the same 9 questions mentioned earlier in this section. The graph is based on 92 students from two different schools. Of the 92 students, 71 of them participated in the education program at their own school and 21 of them traveled to the CSIRO Science Education Centre. The students’ responses follow the same pattern as the overall students. The most important questions to consider are questions 6-9 because they relate specifically to the education program that the students participated in. Question 6 shows that the students liked the education program because the majority of them would like to participate in another such program. Questions 7-9 show that the students are not interested in learning more about the program because they are not extremely interested in watching videos, learning from a website or talking to other students online about the subject.



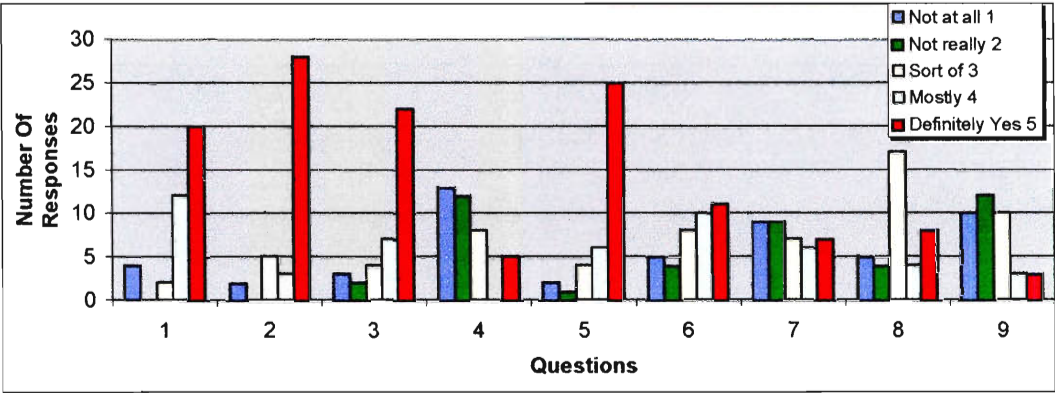
9th & 10th Grade Forensic Frenzy

The graph below represents the 9th and 10th grade students who participated in the Forensic Frenzy education program. The graph represents 32 students who participated in the education program here at CSIRO Education Centre. Questions 6-9 are the questions that relate to the specific CSIRO Education program and are answered in the same way as the previous group of 7th and 8th graders. The only difference is that for this education program the students would like to see videos related to the education program. This is shown in question 7 where only 2 students circled “Not Really” and zero circled “Not at all”.



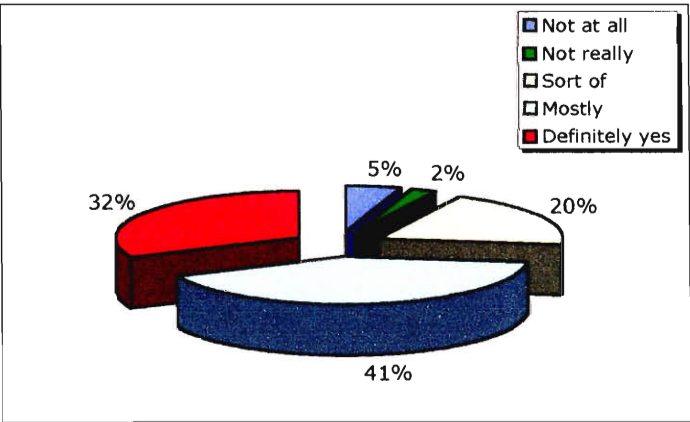
12th Grade – Materials and Structures

This group of students answered the 9 questions in the same similar patterns as the total student population that had participated in a CSIRO Education program. This group also felt that they would like to participate in another program like the one they just did but did not care to learn or discuss the topic online. The graph below displays the results of the survey.



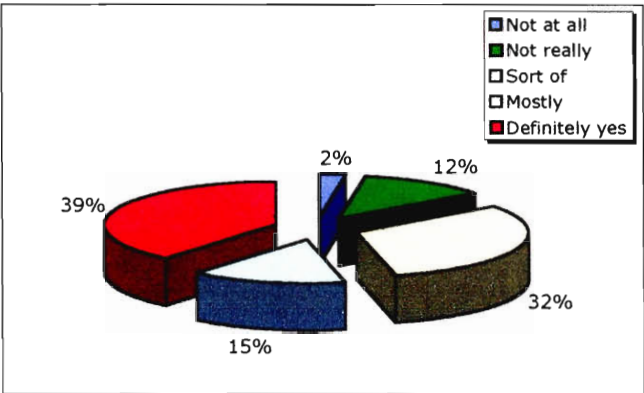
12th Grade Materials and Structures

Non-participant Student Survey



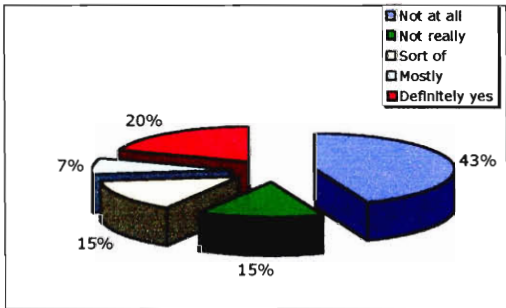
1. For you, are computers easy to use?

The 41 students who completed this survey felt the same way as the 310 students who completed the first survey in the fact that the majority of them felt that computers were easy to use. This reinforces the suggestion before about how students would not have a difficult time dealing with supplements utilizing electronic media.

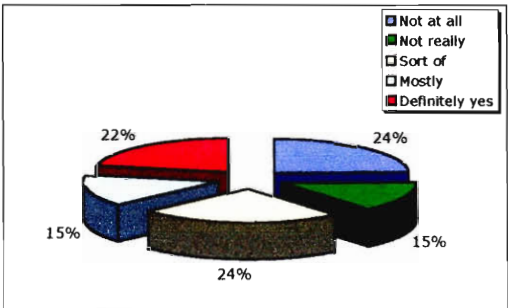


2. Do you think that the Internet is simple to use?

As one can see from the pie chart above, 22 of the 41 students circled either “Definitely Yes” or “Mostly” as their opinion. This also reinforces the previous suggestion from the first survey by saying that the students do not find the Internet difficult to use. This again suggests that supplements utilizing electronic media would be easy for students to understand.

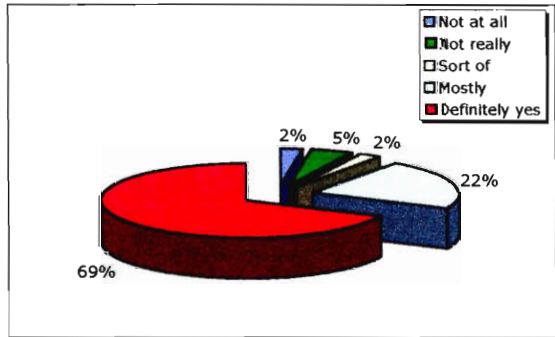


3. Do you go online often at home?



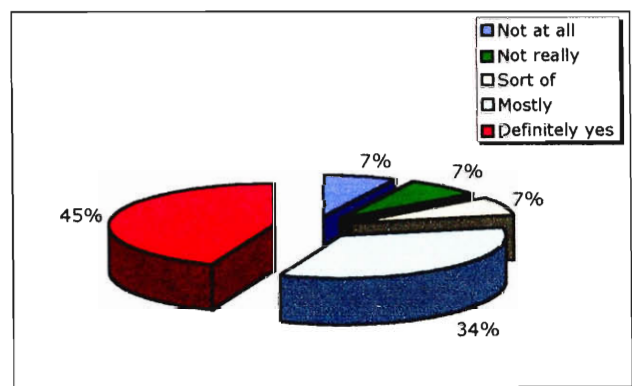
4. Do you go online often at school?

From the graphs above, one can see that most of the students do not go online very often at home. The graph also shows that the students who go online at school are fairly evenly spread between those that do and those that don't. This suggests that the students have only limited access to the Internet.



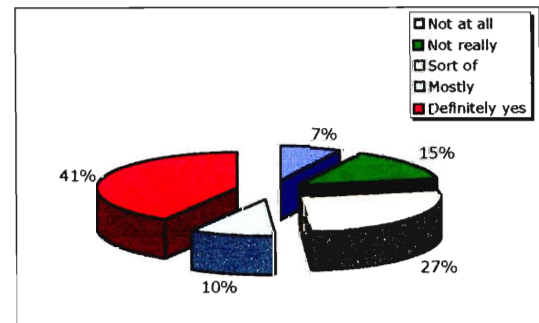
5. Do you enjoy using the Internet?

The results to this section are fairly obvious from the graph above. Only 4 out of the 41 students did not circle either “Mostly” or “Definitely Yes”, which clearly displays that the students enjoy using the Internet. This also reinforces the suggestion from the previous section about how the students have limited access to the Internet.



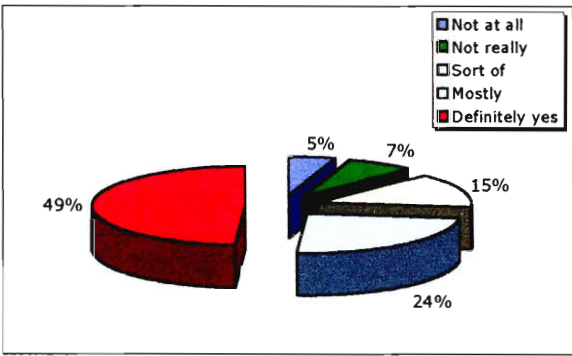
6. Would you be interested in doing some of your class work online?

This question is where the two surveys start to differ a little. For this question 32 of the 41 students answered either “Mostly” or “Definitely Yes”. It is obvious from the graph above that these students would like to use the Internet more in their schoolwork.



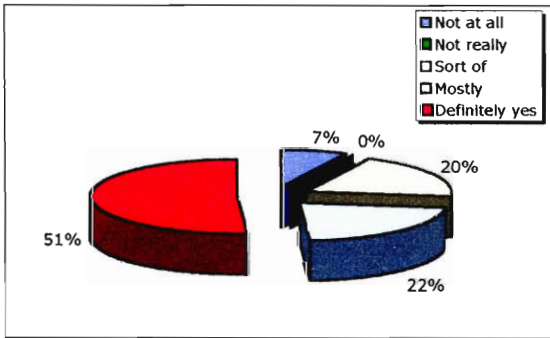
7. Would you like to be able to see educational videos online?

As one can see from the graph above, many of the students would like to see educational videos online. Only 9 of the 41 students were actually apposed to or not interested in online educational videos. These data suggest that online educational videos would be greatly appreciated by most students.



8. Would you like to learn in school by going to a Web site?

This group of students answered this question with the majority of them wanting a Web site that they could learn from. This can be seen in the graph above.



9. Would you like to be able to discuss schoolwork with your classmates online?

This group of students answered question 9 in a unique way. Before when the students who have participated in the education programs were asked if they wanted to discuss the topic that was just presented online, they mostly answered that they were not interested in doing so. In this case 30 of the 41 students who have not participated said that they were interested in discussing schoolwork online. These questions are not the same but are fairly similar in nature. This can be seen the graph above.

Appendix L: Field Notes from Observation of CSIRO Education

Programs

Field Notes from CSIRO's "Forensic Frenzy" Education Program

Presenter: Merrin Fabre

- Merrin started off with a discussion of CSIRO, describing what the initials stand for and some of CSIRO's notable accomplishments.
- She next challenged the students to think of how they would go about solving a murder mystery. She also asked them what qualities they think are necessary for a forensic scientist to have, as she handed out the worksheets for the students.
- The teacher read aloud the scenario of the murder they would be investigating, & Merrin asked the students to think about what they could know right off the bat.
- Merrin then introduced the suspects to the students and challenged them to think about why each person could be the murderer, based on their description.
- After reviewing the papers, she briefly went over each station that the students would be going through in their investigation.
- After going through these stations, Merrin let the students have a crack at them.
- * By the end, I don't think anyone had finished all of the tests/stations. Perhaps if some preparatory material could be delivered electronically, it would yield more time for the hands-on activity.
- A "storyboard" was displayed at the end and Merrin explained how evidence from different police departments is often compiled in this way.
- Each aspect of the program was then discussed in detail, and the evidence against each suspect was gathered and posted.
- Students were finally asked by their teacher to write a half-page paper on who they think committed the crime and why they think that person committed it.

Field Notes from CSIRO's "Gene Tech" Education Program

Presenter: Chris Krishna-Pillay

- Chris started off with a discussion of CSIRO, describing what the initials stand for and some of CSIRO's notable accomplishments.
- He then spent about 10 minutes going over some theory on genes, chromosomes, DNA, and genetic analysis techniques, including the DNA analysis they would be using. Through this particular technique, scientists can match DNA at a crime scene to the DNA of suspects, and this was the hypothetical situation that formed the theme of the program.
- Chris showed the students how to use a 40-microliter pipette and explained its importance in the program and to scientists.
- There was then a short 5-minute time period in which Chris ensured that the students were familiar with the proper use of the pipette.
- Chris then set up a video camera with a TV and prepared a plate of gel to place some DNA samples in. Volunteers from the class placed the dyed DNA of each suspect in the proper place in the gel. Chris then hooked the plate up to an electric current, which would separate parts of the DNA so they could be matched.
- For the second section of the program, Chris explained to the students that they would be extracting actual DNA from crushed peas in the form of powder in a test tube.
- After breaking the cell walls of the pea cells by crushing them and destroying the cell membranes with chemicals added to the test tubes, the components to the pea cells were all that was left. The test tubes were then placed into a centrifuge so that the heavy components would sink to the bottom, including the cell nucleus, the source of DNA.
- By adding another chemical, the nuclear membranes were destroyed, leaving a layer of visible DNA in the test tube, as Chris explained.
- One really neat part of the program is that the students could actually take this DNA home.
- At the end of the program, Chris discussed the importance of this kind of science and the scientists who work in this field, and described how it could change the world.
- The program concluded with an interesting discussion of cloning and ethics.

Field Notes from CSIRO's "Materials & Structures" Education Program

Presenter: Simon Matheson

- First, Simon gave some basic background on the experiments. He then went over what the machines set up around the room were used for.
- He next showed a typical graph and used it to explain some terms that would be used during the activity, and some properties and general principles of material science.
- The students would be using the first large machine he talked about to break some samples and measure their various properties (elasticity, tensile strength, etc.) using the computer nearby.
- The next machine was a simpler one that would measure the force, tension, and compression of a few pre-designed trusses, depending on where a force was applied.
- Third, he showed the machine that would break some pre-designed structures, and challenged the kids to guess which piece of wood in the truss would break first. The computer on this machine would save the data obtained from the break. He then showed exactly how to use it.
- The next machine would stretch a sample until it breaks and then produce another graph.
- The next experiment involved heating a sample with a flame till it was red hot, then letting it cool either slowly or quickly. The heating was also done at different speeds. The sample, after cooled, would then be bent several times until it breaks. The amount of bending would roughly determine the amount of energy necessary to break the sample.
- Next, they would simply examine a balance beam and the forces on it as a weight was moved across it.
- Next, Simon explained a pendulum-type device that would smash samples. By measuring how high the pendulum swings after breaking a sample, a proportion of the energy lost could be estimated. The samples to be used were again of different temperatures.
- Another device to stretch pieces of lead was finally explained.
- The students then split into five groups (there were 24 total students) and got going on the experiments based on the given notes.
- * I personally noticed that their level of attention seemed to be much higher than what I am used to seeing with physics programs. The hands-on approach seems to engage them well.

- Caroline, a staff member at CSIRO Education, said that there definitely are those kids who inquire about a CSIRO website to find more cool stuff.
- Simon, Caroline, and Andrea were available to help the groups the whole time. With the first three machines, the students did seem to require some kind of help to use them.
- According to Andrea, who has 20+ years of experience teaching, the Year 12 programs have a dedicated lab such as this orange room. The programs offered by CSIRO do in fact fulfill a curriculum requirement for these schools. There are obvious problems with packing program materials and taking them on the road, including the fact that some of it is glass and some of it is just too heavy. She also said that CSIRO generally expects the teachers to do some sort of preparatory work with their students before they attend a program such as this materials one. The teachers teach the theory, while this provides some kind of practical experience.
- Once time was up (about 2 hrs 15 min in), Simon concluded by talking about the challenges he issued at the beginning of the program, including whether or not students thought materials would break if they actually stood on the sample or otherwise hung their weight from it. After discussing this, he sent the children on their way.

Field Notes from CSIRO's "Energy and Its Uses" Education Program

Presenter: Andrea Nelson

- Andrea started the presentation by demonstrating how to knock an apple off the head of a student using an air cannon. She then filled up the cannon with smoke and said how the energy was used to blow the air and knock the apple off.
- There were a variety of experiments for the students to try. Little poppers and pendulums that used different forms of energy were among these experiments. Andrea explained all the different ways energy was used to "do work"
- The students seemed really interested in the program as well as having fun while participating in the program. They all wanted to continue doing the experiments, but Andrea needed to end.
- The teachers also tried the experiments along with the children and seemed to be having as much fun as the children. Multiple times they said that they were going to do this with their kids on their own.
- Andrea answered any questions that the students had as well as demonstrating again the air cannon, to the delight of the students.
- During the tea break, a teacher commented to me how she really didn't understand the concepts behind the demonstration, and how she wanted to learn what kinetic energy was.

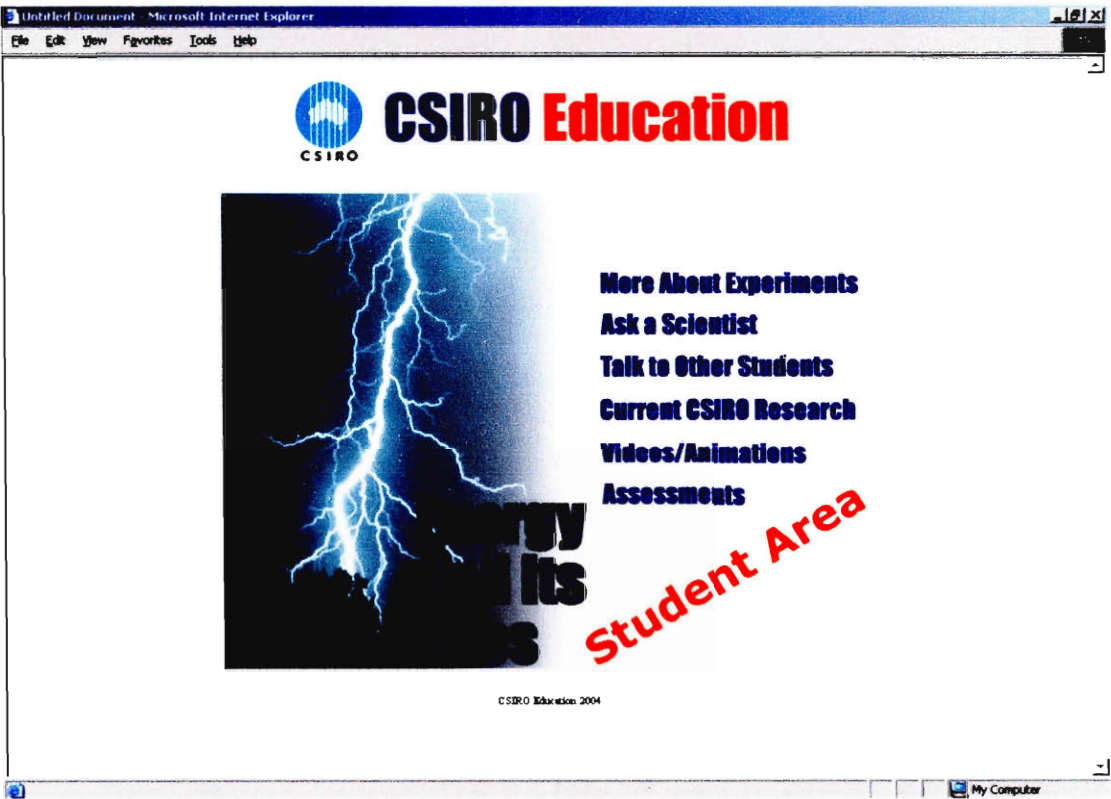
Field Notes from CSIRO's "Cool Chemistry" Education Program

Presenter: Merrin Fabre

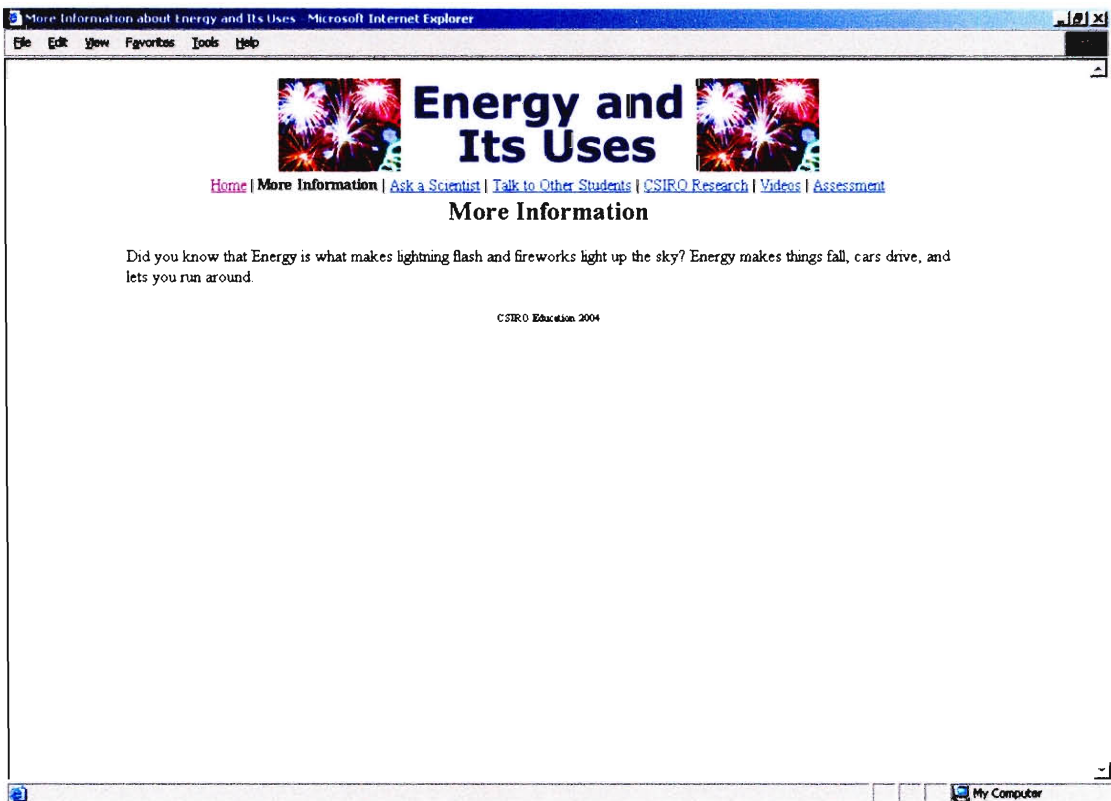
- Merrin started the demonstration with a neat experiment that essentially turned seemingly clear water different colors and then back again. The kids really enjoyed this, and it got their attention right away.
- This presentation had many different experiments that showed everything from how clothes protect us from UV light and how to make slime. Merrin went around to each experiment and showed how to conduct it and briefly what the chemistry was behind it.
- The room was pretty crowded so the kids didn't all get a chance to do the experiments. But Merrin suggested that the ones who didn't get a chance to do one of the experiments could ask their classmates. She concluded by speaking about how these experiments dealt with chemistry.

Appendix M: Screen Shots of Sample Website

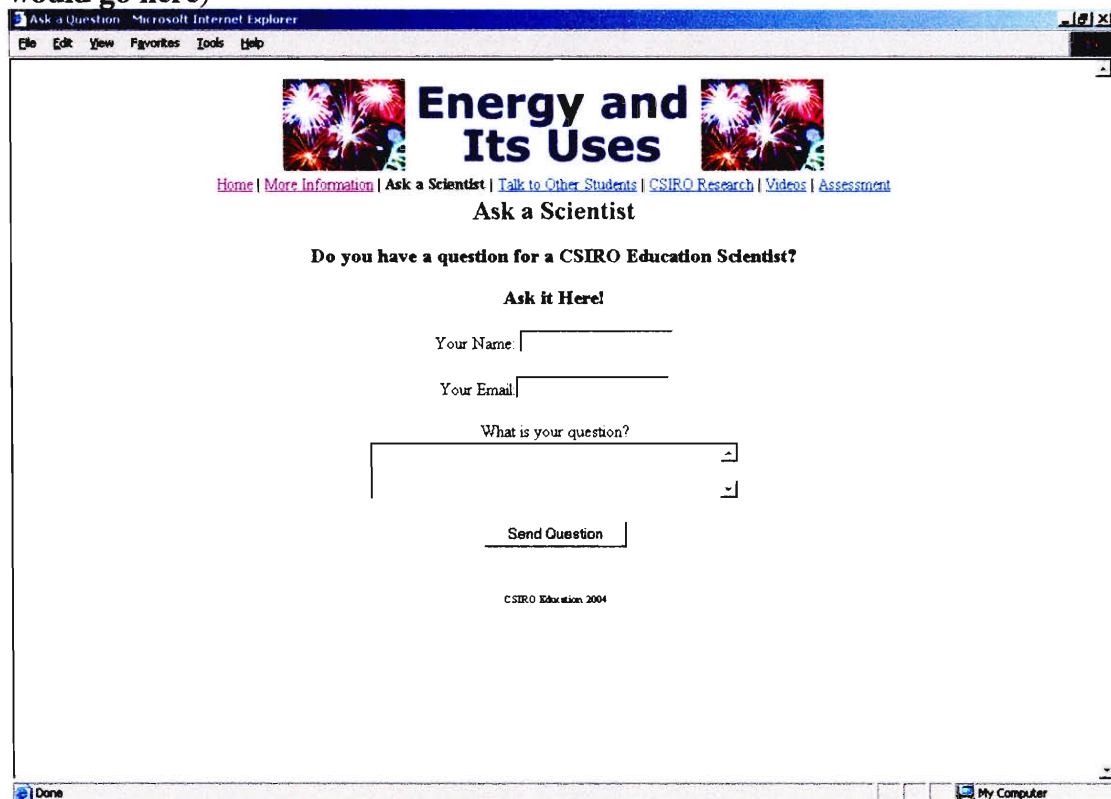
Student Website



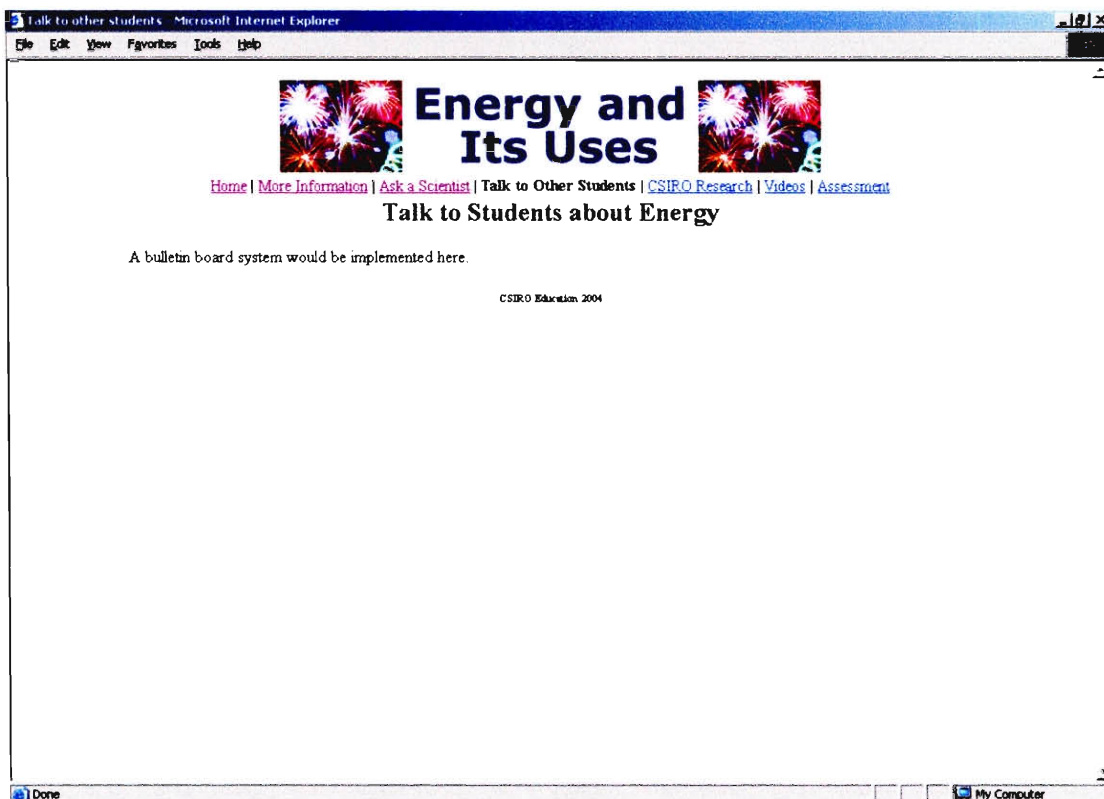
Main Student Page (Links go to the other student pages)



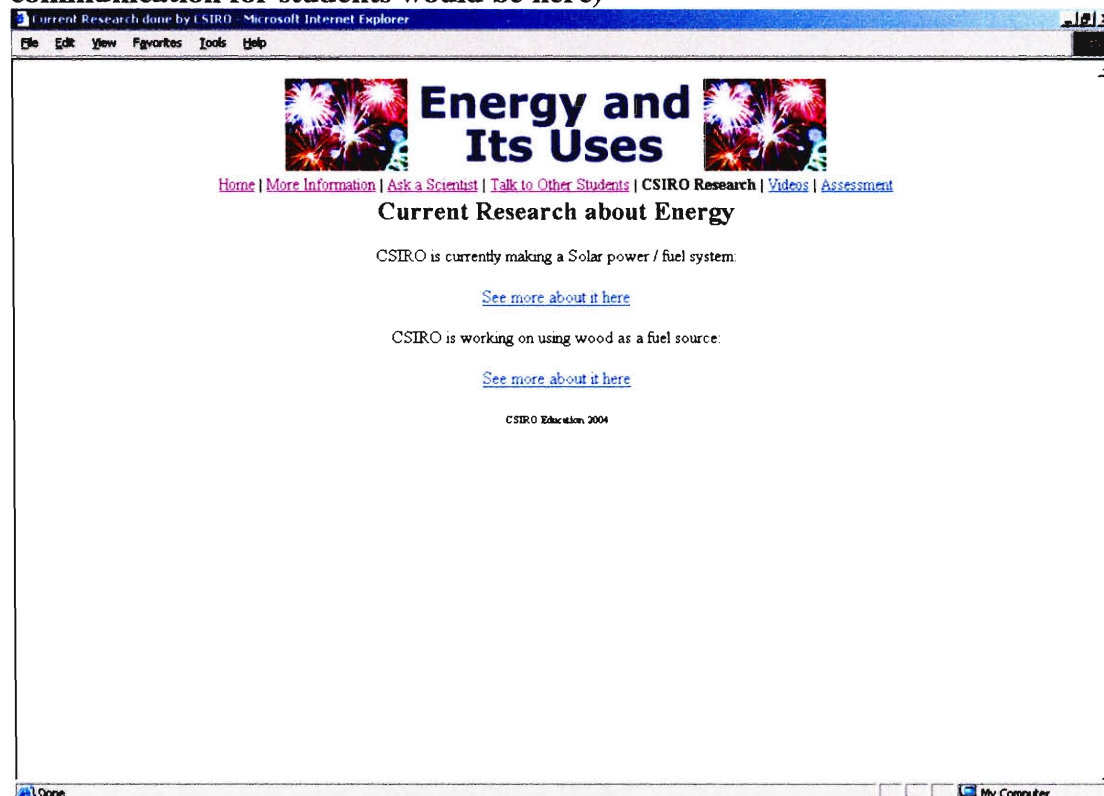
More Information Link from the Main Page (Extra Information about Program would go here)



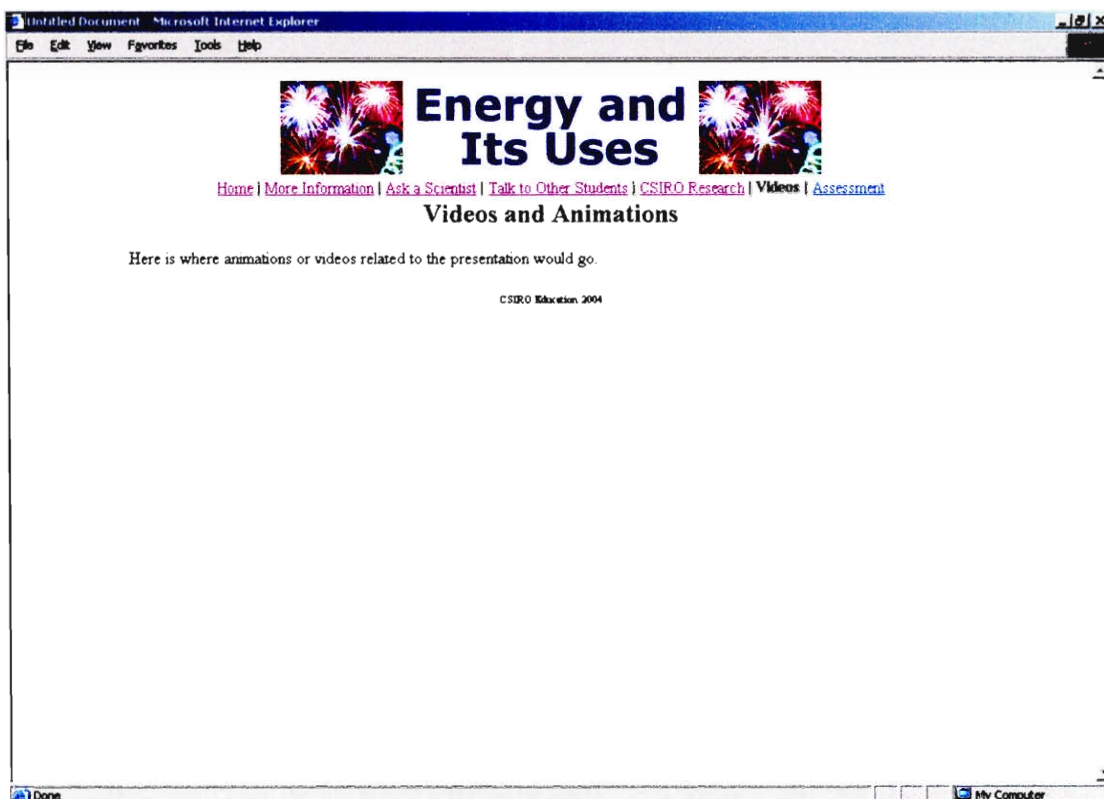
Ask a Scientist link from Main Page (Here you can ask a question to a CSIRO Scientist)



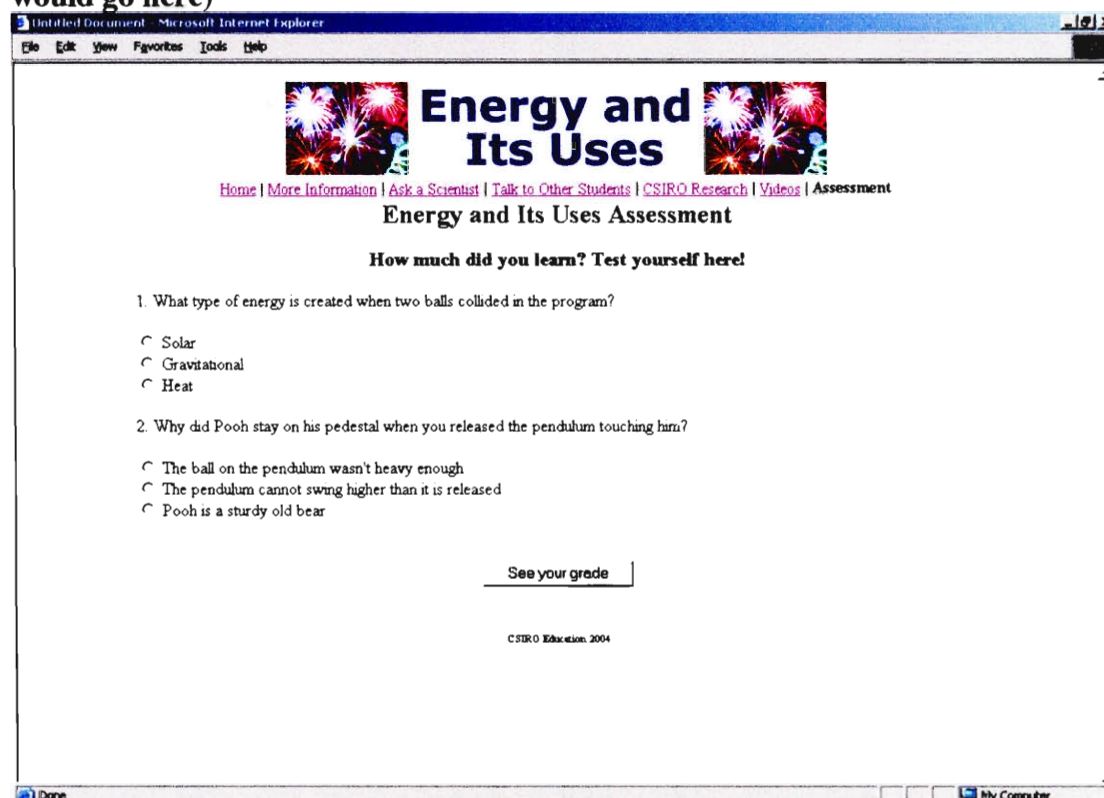
Talk to Students link from Main Page (A bulletin board or other method of communication for students would be here)



Current CSIRO Research link from Main Page (Links refer to CSIRO main page where students can see what scientists are doing now)



Videos/Animation link on Main Page (Lists of Videos and interactive animations would go here)



Assessments link on Main Page (This is a sample assessment, the results would be sent to teachers via email)

Teacher Website

Energy and Its Uses - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Energy and Its Uses

[About The Program](#) | [Background](#) | [Activities](#) | [Post-Class Activities](#) | [Related Multimedia](#) | [Glossary](#)

Energy is an essential ingredient for life. Our bodies need it to survive and its use is an integral part of today's society. In this class, suitable for year levels P - 6, students identify transformations of energy involving electricity, heat, light, sound and movement. They also investigate the workings and uses of devices that transfer or transform energy. Incorporating a hands-on section, this program examines sources of energy and various methods of energy storage and the useful effects of energy conservation.

CSF II Links

This program follows the Physical Science strand of CSF 2 *Energy and its Uses*. The levels covered are follows:

1. Describe, using appropriate language, scientific explorations of the chemical, physical and natural world.
2. Identify simple patterns in observation arising from explorations of readily observable phenomena.
3. 1. Identify transformations of energy involving electricity, light, sound, heat and movement.
4. 1. Design, build and describe the operation of simple devices that transfer or transform energy.

[CSIROSEC Melbourne Home Page](#) | [Other Programs](#) | [Contact Us](#)

My Computer

Main Teacher Page (CSF Links should be put on this page)

Energy and Its Uses - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Energy and Its Uses

[About The Program](#) | [Background](#) | [Activities](#) | [Post-Class Activities](#) | [Related Multimedia](#) | [Glossary](#)

Background Notes on Energy


What is energy? It is all around us. We use it all of the time in our everyday lives, yet we cannot see it or touch it. We know it is there because we can see its effects. Energy is usually defined as "the ability to do work". In fact, doing anything in this universe involves either converting energy from one form to another or moving it from one place or object to another. For example, walking involves transforming the chemical energy in food into forward motion, heating a house with oil or gas involves changing the energy in fuels into heat, hitting a ball with a bat involves transferring the energy from the bat to the ball.

The transforming or transferral of energy usually requires the action of a force to take place. In the bat and ball example above, the force that the bat exerts on the ball transfers the energy between the two objects.

Forms of Energy

There are many different types or forms of energy. Some of the more common ones are listed below.

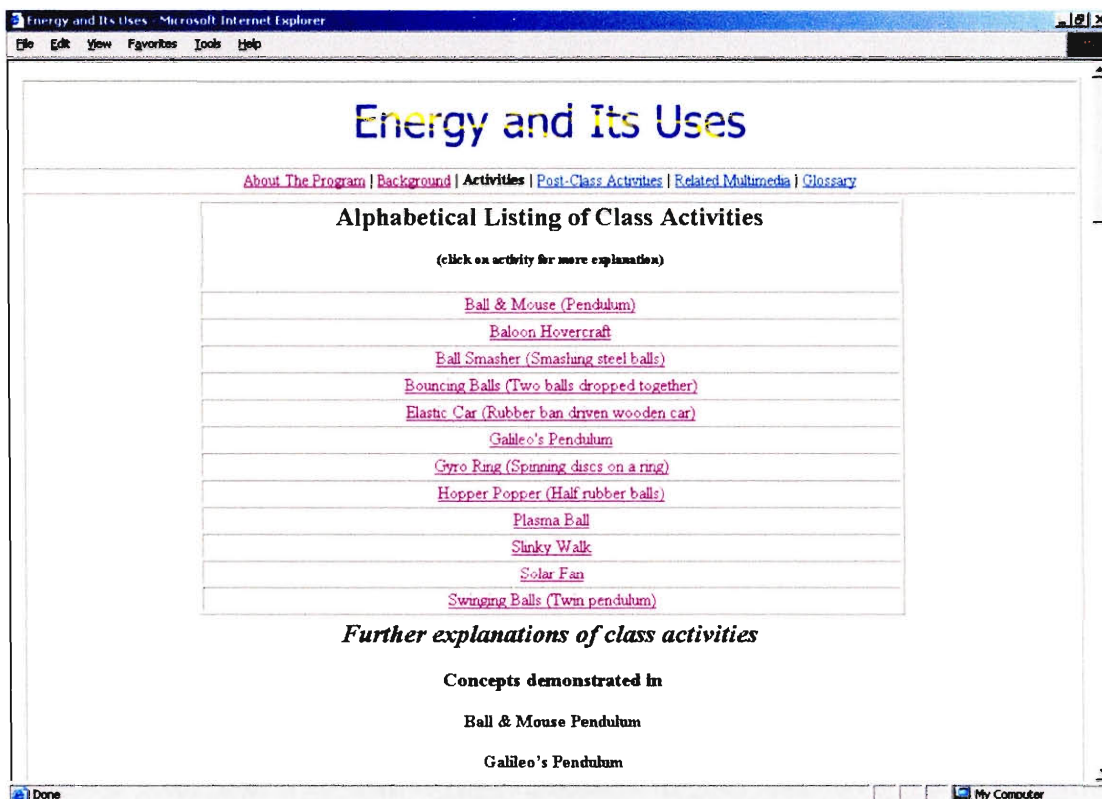
Kinetic Energy:



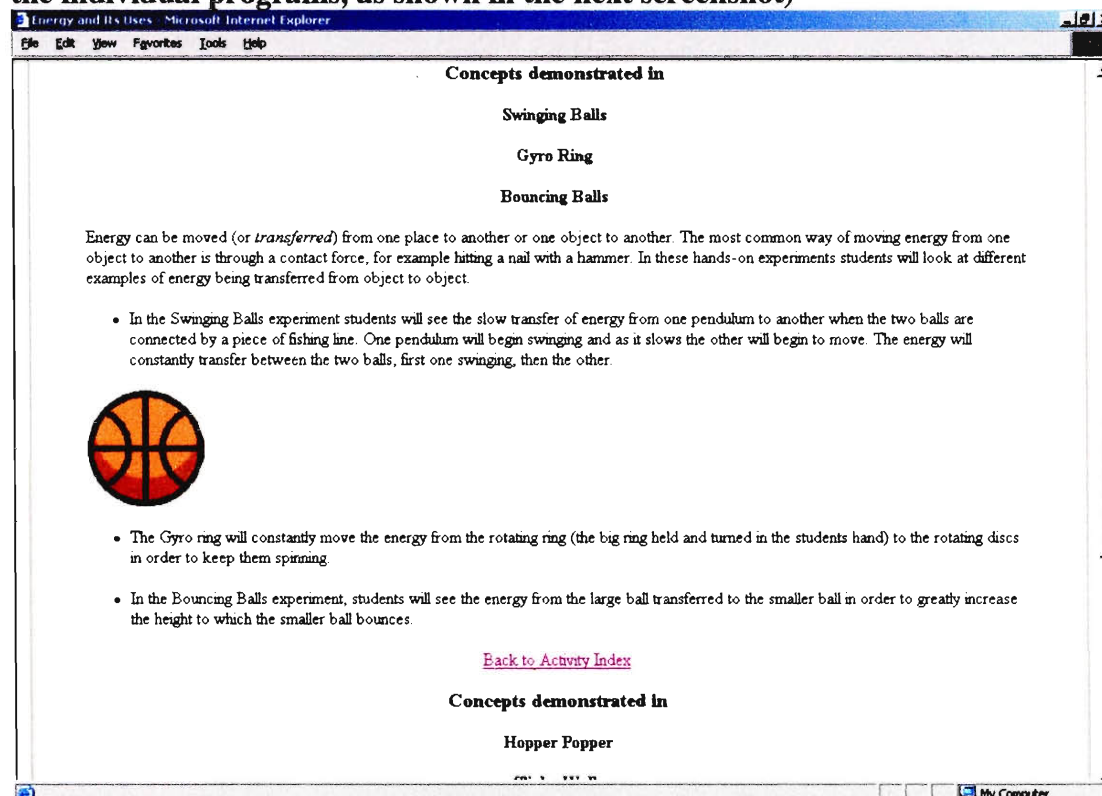
Kinetic energy is the energy a body has by virtue of its motion; an air mass moving across the ground (wind) has kinetic energy that can either be converted to electricity or transferred to mechanical drive by a windmill. Any body that is moving has kinetic energy. The faster it is moving, the more energy it has.

My Computer

Background page (Background information for teachers would go here)



Activities Page (This is the list of activities that can be clicked to bring the user to the individual programs, as shown in the next screenshot)



An Activities Page (A demonstration of a specific activity's information)

Energy and Its Uses - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Energy and Its Uses

[About The Program](#) | [Background](#) | [Activities](#) | [Post-Class Activities](#) | [Related Multimedia](#) | [Glossary](#)


Post-Class Activities:

(click on an activity to find out more information)

- [Turning up the Heat](#)
- [Solar Cooker](#)
- [Clucking Cup](#)
- [The Rubber Refrigerator](#)
- [Balloon Powered Boat](#)

Turning up the heat

This experiment shows you that though black clothes may look cool, they don't feel cool. The amount of solar radiation absorbed (or reflected) depends on the colour of the material it hits.



What You'll need:

- * Three glass jars with lids
- * Blu-Tack
- * Black paint or paper

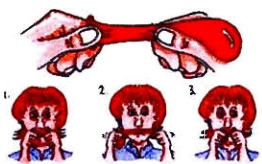
Done My Computer

Post-Class Activities Page (Top of the page with clickable index of activities)

Energy and Its Uses - Microsoft Internet Explorer

File Edit View Favorites Tools Help

The Rubber Refrigerator



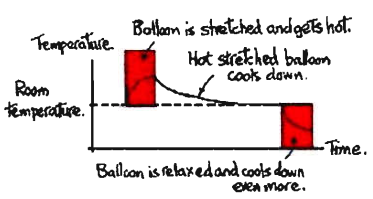
Hold the neck of a balloon with both hands as shown. Feel its temperature with your upper lip (1).

Now, stretch the neck as far as possible and touch it to your upper lip again (2). Has the temperature changed?

Keep the balloon in this stretched condition for about 20 seconds. Now, let the balloon relax quickly and touch it to your lip straight away (3). How does it feel now?

It's quite remarkable what happens. The balloon heats up when you stretch it, and cools down when you relax it (as shown in the graph). You've used energy to make something cold by first making it hot. A refrigerator does this, too. When you pull on the balloon sharply, it heats up. Then, because the stretched balloon is hotter than the surroundings, it cools down again.

Then you put the whole thing into reverse: the cooled, stretched balloon contracts and cools down to a temperature lower than before.



Temperature

Room temperature

Time

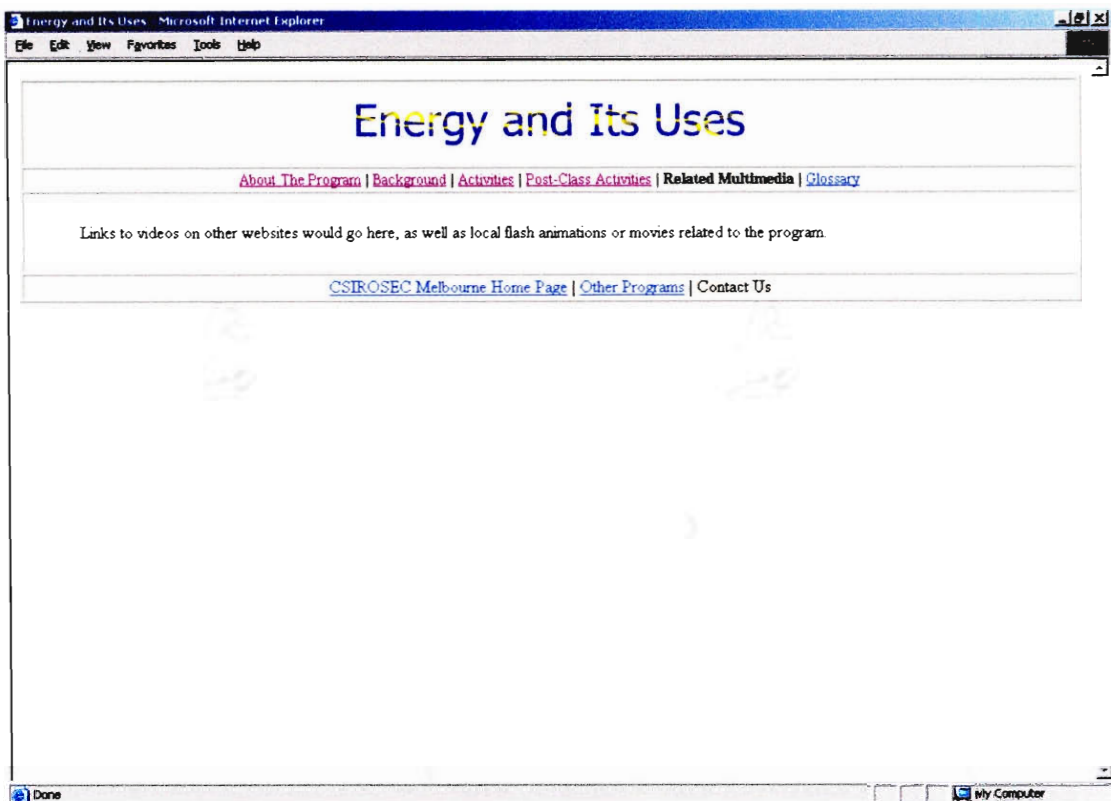
Bottom is stretched and gets hot.

Hot stretched balloon cools down.

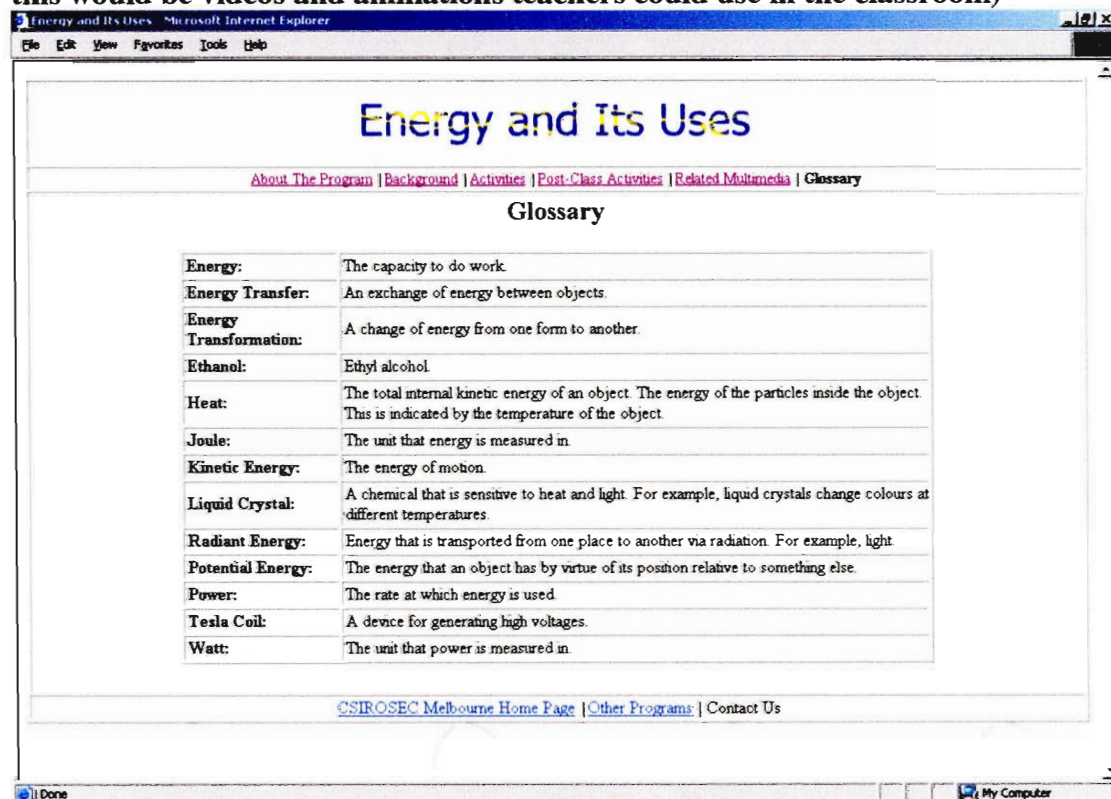
Balloon is relaxed and cools down even more.

Done My Computer

Post-Class Activities Page (A specific example of a program)



Related Multimedia Page (Similar to the Videos/Animation page for students, this would be videos and animations teachers could use in the classroom)



Glossary Page (List of terms that are needed to know for the program)