1991

Characteristics that determine the holding power of computer-based exhibits at Scitech Discovery Centre

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CHARACTERISTICS THAT DETERMINE THE HOLDING POWER OF COMPUTER-BASED EXHIBITS AT SCITECH DISCOVERY CENTRE

BY

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A Thesis Submitted in Partial Fulfilment of the Requirements for the Award of

Bachelor of Education with Honours

at the School of Education,
Edith Cowan University

Date of Submission: 6/6/1991

USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

ABSTRACT

Scitech Discovery Centre is a hands-on science and technology centre located in the City West Complex, West Perth. The Centre contains over 160 interactive exhibits including a number of computer-based exhibits that cover topics not easily incorporated in standard interactive exhibits.

The problem considered in this study was the observed low percentage of visitors completing the programmes at seven of these computer-based exhibits. The author used unobtrusive observation and survey methods of data collection, for 245 visitors, on Sundays over a three month period.

The study was to determine two things, firstly the holding power of the exhibits, and secondly, the characteristics that determine holding power. Holding power was defined as the percentage of visitors completing the programme.

Analysis of the data showed a range of holding powers from 17% to 77% with further variations according to population subdivisions.

The main factors found to determine the holding power of the exhibits were placed in two categories. Internal characteristics were those found within the exhibit and included screen design, programme design, level of interaction and input devices. External characteristics were those brought to the exhibit by the visitor or those already a part of the environment. They included visit timing, topic interest, and the age and gender of the visitors.

It was not possible to identify a set of positive or negative characteristics relevant to all computer-based exhibits, but the findings lead to a set of recommendations for current exhibit modifications and guidelines for future exhibit development.

DECLARATION

I certify that this thesis does not incorporate, without acknowledgement, any material previously submitted for a degree or diploma in any institution of higher education and that, to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where due reference is made in the text.

Signature

Date 26/5/1991

ACKNOWLEDGEMENTS

The author wishes to acknowledge the support and guidance provided by Ron Oliver, Research Supervisor for this study. His on-going encouragement and advice have been invaluable.

Acknowledgement should also be made of the continued support and interest of Dr Ann Ghisalberti, Manager of Science and Education at Scitech Discovery Centre. This support and the cooperation of all Scitech staff have helped make this study possible.

TABLE OF CONTENTS

LIST OF TABLES

Chapter 1

Introduction

Background to the Problem

Scitech Discovery Centre is a hands-on science and technology centre located in the City West Complex, West Perth. The centre contains approximately 160 interactive exhibits dealing with various fields of science. Since opening in August 1988, almost 390 000 people have visited the Centre. (For further information see Appendix A)

Scitech is a non-profit public foundation run by a voluntary board of directors and attracts three main areas of funding:

(a) WA government funding, currently at the rate of one million dollars a year;
(b) sponsorship from the corporate sector;
(c) admission fees from visitors.

Because of this funding, Scitech must strive for high levels of satisfaction in terms of both education and enjoyment for all types of visitors. Within the Centre's staff, there is a growing awareness of the need for continual evaluation of the exhibits and overall visitor satisfaction.

Exhibits in the Centre involve varying degrees of interaction, from pushing buttons to using the whole body to create coloured shadows. There are also a number of computer-based exhibits which cover areas that may not be easy to develop in other interactive forms.

During 1988, the author, an Education Officer at Scitech Discovery Centre, carried out a small observational study of five computer-based exhibits to determine visitor usage. The main findings of this study were that;
(a) at least 50% of the visitors who used these exhibits walked away without finishing the programs,
(b) the percentage of visitors who finished the programs ranged from 17% to 94% across the five exhibits observed.

Since then, with the replacement and addition of new exhibits, there are now seven computer-based exhibits in the centre.

Statement of the Problem

The problem underlying this research is that on average the computer-based exhibits do not keep visitors' attention long enough for them to complete the programs. There may also be certain types of visitors for whom these exhibits elicit even less attention.

Some of the computer-based exhibits are obviously more effective than others, but there is no objective evidence to explain why this is so. At this stage there is a lack of research-based guidelines for designers of exhibits of this type.

These concerns on exhibit development and evaluation need to be addressed in order to determine plans for future exhibits and exhibit modifications. Plans also need to take into account the nature and numbers of visitors to the Centre.

This research was to build on the initial study and to determine; (a) the relative holding power of the seven computer-based exhibits, and (b) the characteristics which influence their holding power. It was not the intention of this research to identify exhibit effectiveness in terms of the amount of learning that took place.

Review of the Literature

Within this review of literature, four main areas were considered in detail. Initially a review of software design and evaluation research was carried out. This determined any relevant characteristics that had already been identified as factors affecting software holding power.

After consideration it was decided not to review research in the area of attitudes to computers, because in most cases the computer-based exhibits at Scitech were designed not to look like standard computers and do not have keyboards as input devices.

Next, the overall evaluation of educational museum and science centre exhibits was reviewed with the objective of identifying characteristics of "ideal" or "effective" exhibits. This also included research on the holding power of exhibits in such museums.

The third stage involved reviewing literature relating to computer-based exhibits in museums and science centres. The final stage of the literature review related to the research methods appropriate to this study.

Software design and evaluation.

There is currently much debate in the area of computer use in education settings. Researchers are working to compare the effects of computers to other more traditional methods of instruction. The bulk of this research tends to concentrate on how much is learnt rather than the user's choice in using the hardware and software.

The focus of this area of the review is on the design principles of computer software that increase users' attention and time spent at the program. Within this research this is referred to as "holding power".

Carrier and Sales (1987) address the issue of software design by describing a taxonomy of three levels including context, strategies and features. They suggest that designers need to consider the three levels and how they interact with each other in order to increase the effectiveness of the software. They discuss generally the benefits to students and the enhancement of strategies for learning, but make no mention of students' interest in the software.

Weller (1988), on the other hand, discusses the specific factor of interaction as an important application of the computer's capabilities to increase software effectiveness. He includes points such as learner control over sequencing and pacing of information as motivating factors which can decrease anxiety and improve attitudes. Other factors mentioned are clear accessible directions, well-designed screens and appropriate graphics.

Hazen (1985) describes four software design principles that also focus on the aim of imparting knowledge or content. There is however, some discussion of features that will

motivate the user. These include the use of questions to check progress and positive feedback that encourages and points to correct responses. The points discussed by Weller (1988) are also echoed in Hazen's article. These are well-designed screens and learner control of sequencing and pacing. Hazen also suggests that slow or repeated graphics can be tiresome and decrease the users' attention.

Design principles for educational computer games are relevant to some science centre computer-based exhibits. Reynolds and Martin (1988) list seven design guidelines for this type of software. They make the point that in using game strategies, "The students' attention span is extended and a feeling that learning is fun is created."(p.46) This article promotes a balance between interesting students to increase attention and aiming to teach content.

The particular design characteristics relevant to the computer-based exhibits are considered to be: "player control of interaction and game progression; incorporation of challenge, fantasy and curiosity; prompt feedback on performance and progression; and positive reinforcement that is positively timed." (p.45)

Reynolds and Martin also discuss briefly the use of these and other guidelines in the evaluation of software and suggest that students and other software users should be

more involved in this evaluation process. This lends support to the use of visitor surveys to evaluate computer-based exhibits.

Jonassun and Hannum (1987) supported the previous studies by reviewing and listing research-based principles for software design. The suggested principles echoed those already stated and reinforced the importance of interaction, feedback and learner control.

Evaluation of software in many cases reinforces the important design principles stated in the previous literature. In two such articles, Schuell and Schueckler discuss the common factors used by software evaluators.

In the first article (1989a), 16 software packages were evaluated against criteria based on principles of effective teaching and learning. The particular criterion of interest to this study was the determination that "Motivation and attention is maintained throughout the program." (p.143) Their average rating of the programs on this criterion was only slightly above the middle of the scale. They pointed out that this was a relatively low rating considering the potential capability of computers to achieve this aim.

In Schuell and Schueckler's second article (1989b), they compared 19 software evaluation forms (including both a

checklist type and a written appraisal) in order to identify common factors and principles. The most relevant finding of this comparison was that less than half the forms reviewed contained information on interest and motivational factors.

The review in this area indicates that there are a number of factors which contribute to the user's interest or motivation in using the programs. Factors which may be relevant to the proposed research include;

(a) interaction,
(b) positive feedback,
(c) appropriate use of graphics,
(d) learner control of sequencing,
(e) learner control of pace,
(f) clear directions.

The literature review demonstrates that though educators generally acknowledge the place of motivation in learning theory, it is not discussed greatly in literature relating to design and evaluation of software.

In informal learning settings such as Scitech Discovery Centre, where computer-based exhibits compete with other exhibits for visitors' attention, these design principles are even more important.

Evaluation of exhibits.

The next field of research concerns the evaluation of exhibits in museums and science centres. Research in this area has been undertaken for at least sixty years with varying degrees of depth and formality.

Within the recent literature, researchers tend to agree with Borun (1989, p.36) who states that "Evaluation is the process of finding out to what extent a program produces the intended impact". Miles, Alt, Gosling, Lewis and Tout (12, p.126-127) discuss the reasons for the evaluation of exhibits and suggest that they can be tied into the various stages of evaluation. They name these stages as; front end analysis, formative evaluation and summative evaluation. At each stage the staff involved in the process use the evaluation as a design tool for the next stage.

These stages of evaluation are also discussed by Borun (1989, p.40) who identifies summative evaluation as the one most often carried out in science centres, particularly those still in the "setting up stages." This is particularly relevant to this research as an evaluation of completed exhibits in a relatively new science centre.

Borun (1989, p.39) also discusses the setting of objectives for exhibit evaluation around five main exhibit concerns; attracting power, holding power, proper use, instructional

power and affective power. Of these five, the most relevant to this study is holding power because the stated problem involves visitors not completing programs on computer-based exhibits.

Borun (p.39), defines holding power in question format: "How long does it take to see the display and what percentage of the people who stop at it stay this amount of time or longer?"

The measurement of the attracting power and holding power of exhibits is also a part of the research carried out by Alt and Shaw (1984). In this study visitors were interviewed in order to determine characteristics of an "ideal" exhibit.

They defined holding power as "The average time spent at an exhibit by a sample of visitors given that the visitors had stopped" (p.28). The characteristics generated by the interviews were classified into seven groups, five of which seem to contribute to exhibit holding power. They are; attractiveness and noticeability, clarity and ease of comprehension, requires visitor responses, emotional reactions, visual effect and appeal to different ages.

The main conclusions were, however, that it was not possible to generalise ideal characteristics across

different exhibit types and that research should be conducted using specific types. Due to the stated problem of visitors not completing the computer-based exhibits, it was decided to adopt a definition of holding power similar to that proposed by Borun.

Information on successful and effective exhibits was also collected by Pollock and McCormick (1988). They surveyed 200 science centres and received feedback on the success or effectiveness of exhibits from the staff. The resulting list of characteristics included many stated in affective terms and related to visitor use and enjoyment of exhibits.

The categories of characteristics most applicable to exhibit holding power were rated the six highest. These were: participatory, visually appealing, informative, visitor identification with the subject, and finally, inherent appeal of the subject. This indicates that museum professionals consider both enjoyment and education to be important objectives for exhibits.

Another issue to be considered in this proposed research was discussed by Koran, Koran and Longino (1986). Their research looked at the relationship between age, sex, attention and holding power with science exhibits. They found that children and early adolescents spent more time at the exhibits and that on average, female visitors spent

slightly more time than male visitors.

These data were collected using interactive exhibits in a largely "display only" museum so the results are probably not applicable to science centres such as Scitech Discovery Centre where the general expectation is that the exhibits are interactive. However, they are factors that should be considered.

To summarise this section, as shown through the research, museum educators believe that within a distracting setting such as a science centre, exhibits must have high holding power if visitors are expected to learn anything. This belief also assumes certain positive links between holding power and learning, though very little research has been carried out to verify this.

Some characteristics thought to increase holding power are;

(a) visual appeal,
(b) ease of use,
(c) clarity of instruction,
(d) subjects of interest to visitors,
(e) appeal to all age groups,
(f) high degree of interaction,
(g) informative nature of exhibits.

These characteristics were considered, in conjunction with those generated by the initial review section, as part of this research.

Evaluation of computer-based exhibits.

Very little research has been carried out on the use of computer-based exhibits in museums and science centres. The single reference available discussed the use of computers as an adjunct to museum displays rather than as exhibits in their own right (Van Rennes, 1981). This research used computers placed next to selected exhibits. These computers acted as teachers, asking questions to stimulate thought about the exhibits. Visitors were then knowledge-tested and the researchers concluded that the computers increased the amount of learning taking place. Again this is a different situation to this research so the results are not very relevant.

It is obvious that this is an area in need of further research particularly with the increasing number of these exhibits in museum settings.

Methodology for research.

In considering methodology for this research, the main areas of literature referred to were those relevant to exhibit evaluation. As a specific field of evaluation, it

was considered appropriate to consider the methods suggested by researchers in other science centres.

The difference between applied and basic research is explained by Feher (1990, p.7). From this it is clear that this study fits into the category of applied research in that "These studies aim to produce information that is directly applicable to the development of better exhibits."

Alt and Shaw (1984, p.25) identify three broad types of visitor-oriented research as "large-scale sample surveys, behavioural observations, and paper-&-pencil tests of knowledge." Smith and Rutgers (1989, p.7) identified similar types of typical science museum research and further describes the questionnaire, survey and observation type as "quantitative in nature and positivistic in approach."

As this study aimed to determine the holding power and the characteristics affecting holding power, it was considered appropriate to combine the observation and survey forms suggested.

Borun (1989, p.40) provides further support for this choice by explaining that, when measuring holding and attracting power of exhibits it is appropriate to use quantitative

observation methods such as timing and counting visitors. This review provides further support for the combination of observation and survey selected for this study. These methods of data collection are appropriate in terms of the research questions posed and the general field of science centre research.

Conclusion

Much of the research in exhibit evaluation shows an increasing awareness that exhibits need to be evaluated in terms of usage as well as knowledge outcomes. The review also indicates that more research is needed comparing different types of exhibits with different styles of visitor interaction.

In considering computer-based exhibits as a particular type of exhibit to be evaluated, there is little relevant research in this field. Principles of educational software design provide guidelines, but they assume a captive audience possibly already motivated by the use of computers. Within Scitech Discovery Centre, the computer-based exhibits have to compete for the visitors' attention with other highly interactive and visually appealing exhibits. It was therefore considered more appropriate to use exhibit evaluation guidelines in conjunction with the software evaluation guidelines.

This research is an appropriate next step with regard to the research already completed and provides a valuable starting point for further research on computer-based exhibits.

Definition of Terms

For use in this research, these terms were defined as:

Computer-based exhibits are those that have a monitor and an input device which allow visitors to interact with the program. Within this research, computer-based does not mean any exhibit that is controlled by computer components.

Internal characteristics affecting holding power are those that occur within the program, or in the exhibit hardware, which includes the input device and screen.

External characteristics affecting holding power include physical features of the centre and factors relating to the visitors such as; their interests, age, gender, time available, group interaction and number of previous visits.

Holding power is the completion rate for the exhibit and will be measured as the percentage of people who complete that program.

Research Question

In order to address the stated problem the main research question was;

Which characteristics of computer-based exhibits determine their holding power for general public visitors?

Because the stated aim of this research was to provide a list of characteristics to consider in the design of computer-based exhibits, the author was mainly interested in internal characteristics. However, as the data included some external characteristics, these were also discussed during the data analysis.

Subsidiary Questions

To answer the main research question the following subsidiary questions were researched.

1. **What is the holding power of each computer based exhibit?**

This question was to provide a rating for the exhibits and to enable a comparison according to their holding power. It was also designed to allow a designation of high, medium or low holding power for each exhibit.

2. Is visitor age and gender a factor in the holding power of the exhibits?

There are many internal and external characteristics that affect the holding power of the exhibits. It was beyond the scope of this research to cover all of these factors.

Some science centre research in the past, Koran, Koran and Longino (1986), has shown principally age and gender differences in exhibit usage. Because of this, the decision was made to specifically consider the gender and age of the participants in the data collected. This decision was also made because of the Centre's aim to cater for a wide age range and both genders.

3. How long do visitors spend at the exhibits?

This question aimed to identify certain segments and characteristics of individual programs that may cause visitors to leave.

4. Which characteristics of each computer-based exhibit are seen by users to increase their holding power?

This question was to provide sets of positive characteristics for each of the exhibits. These lists were

to be combined to form an overall list of characteristics for the seven exhibits.

5. Which characteristics of each computer-based exhibit are seen by users to decrease their holding power?

This question aimed to provide a list of negative characteristics for each exhibit and an overall list of negative characteristics.

Significance of the Study

This research was of immediate significance for the staff at Scitech involved in the modification and design of computer-based exhibits. It also has a wider audience of people involved in the evaluation of similar exhibits at other science centres and museums around the world.

In the field of software design its main significance is in the design and evaluation of voluntary use software. This takes into account the appeal of the software rather than the amount of learning that takes place.

Chapter 2

Methodology

Design

As discussed in Gay (1987, p.248), this research used a causal-comparative method. It was evaluative in purpose and sought to provide generalisable results from the data when analysed.

The research sought to quantify visitor use of the exhibits and determine if there is a cause and effect relationship between certain characteristics of the exhibits and the visitor's decision to complete, or not to complete the program. This can also be considered as a relationship between the exhibit characteristics and holding power.

This research differed from Gay's suggested model in that the two groups, (those completing and those not completing) were not the same in size. An important factor in determining the holding power was the size of these two groups.

The research was based on data collected from visitors using unobtrusive observation and an oral survey instrument. Once collected, the data were analysed to give a comparative rating to the seven exhibits in terms of holding power, as stated earlier. The amount of time spent

on the exhibits was used to discover certain segments of the program which may cause visitors to leave.

It also provided two lists of characteristics, things that visitors like and things that are disliked about the current programs. These suggested characteristics were then compared with the rated list of exhibits to see if the positive characteristics appeared in the exhibits with the highest holding power and the negative characteristics appeared in the exhibits with the lowest holding power.

Population

There are two main visitor groups at Scitech, the general public visiting mainly on the weekend and the school groups visiting during the week. For this research it was decided not to collect data from school groups as their visits usually revolve around provided "PATHWAYS" which do not include the computer-based exhibits. (Pathways are guide sheets based on school topics. They identify relevant exhibits and provide stimulus questions.)

The visitor numbers over the last year were analysed and it became obvious that Sunday afternoon was the most popular time with general public visitors. It was therefore decided to collect data on these days.

The number of visitors on Sundays varied greatly according to a number of variables, the main one being the weather. If it was raining the numbers increased significantly. This was also a consideration in that the data collection took place mainly during winter when visitor numbers were generally higher.

Data Collection

Data were collected only by the author. They were collected on Sundays on a fortnightly basis through the three months of July to September.

The author collected data on each of the seven computer-based exhibits during each observation period. This was done for approximately five hours on a rotational basis through the exhibits. Each week a different exhibit started the cycle to control for population changes at specific times.

At each exhibit, the author observed and collected data from five visitors before moving to the next exhibit. (This was determined as a practical number during initial trialling.) This provided 35 observations and surveys for each of the seven exhibits.

The author used a micro-recorder to record observation data and survey responses. This micro-recorder was quite clearly visible during the oral survey but the visitors' attention were not drawn to it. Only two of the 245 participants surveyed asked about the recorder and were satisfied with the explanation given for its use.

During the data collection, the author wore normal street clothes and a name tag identifying her as a research student at WACAE. It was decided not to wear a Scitech name tag so that participants would not feel any reluctance to comment on the Centre to a staff member.

Ethical Considerations

The main ethical consideration in the proposed study was the collection of data from minors. Wherever possible, parents or accompanying adults were asked to give permission for the surveying of children. This was done on a very informal basis with agreement from all adults approached.

Instrumentation

The data recording instrument (shown in Appendix C) was in two parts. The first part recorded unobtrusive observations

of visitors and included the following;

- date
- gender
- age range (Primary/Secondary/Adult)
- completed program (Yes /No)
- time spent at the exhibit

The second part of data collection was an oral survey form administered as participants left the exhibit. Even though the instrument used is a survey form rather then a questionnaire, as defined by Rummel in Deschamp and Tognolini (1983, p.1), the guidelines suggested in that publication were followed where appropriate.

The survey included the following questions.

1. What did you like about the exhibit?
2. Is there anything you didn't like about this exhibit?

These two questions were recorded and scored during data analysis to create a list of positive and negative characteristics. Multiple responses were accepted.

If the visitor didn't complete the program, they were encouraged to explain what stopped them from doing so. Visitors who completed the program were asked what encouraged them to do so. Visitors were also asked to suggest improvements to the exhibits.

These questions were trialled, over a two week period prior to the study commencing, to determine the type of responses and any possible overlap or necessary change of language. In most cases the set questions were used. However, additional prompts were included to clarify visitor responses when appropriate.

Data Analysis

As the data were collected in two parts, they were initially analysed in two parts. All of the numeric data are given in percentages of the visitor numbers with the percentages rounded to the nearest whole number.

In order to answer subsidiary questions one, two and three, relating to holding power, age or gender differences and time spent, the data collected by observation were put in table form and analysed. Holding power was determined for each exhibit by calculating the percentage of visitors who completed the exhibit program. The holding powers were then rated and compared to identify exhibits with high, medium and low holding power.

The population of participants was analysed to give percentages of adults, secondary aged and primary aged visitors with further subdivisions according to gender. For each of these subdivisions, the holding power was

calculated to allow comparisons of age and gender as factors affecting holding power.

The time spent by visitors was analysed to determine the minimum, average and maximum time spent on each exhibit. In some cases this identified certain points in the program that caused visitors to leave without completing.

The survey data responses were classified into categories of suggested positive and negative characteristics. This gave lists of characteristics that visitors thought increased and decreased exhibit holding power.

Data collected from questions one and three of the survey instrument were combined to provide the list of positive characteristics. Data collected from questions two and four were combined to provide the list of negative characteristics. Responses from question five, asking for suggested improvements, were included on a separate list which is discussed further in the following chapter and detailed in Appendix D.

Classification of responses gave 17 positive characteristics and 23 negative characteristics. A no-response category was included with each set. Many of the categories related to those discussed in the review of literature. However, more specific categories were included

in this study to provide additional information to exhibit designers.

The visitor responses were tallied to give response rates for each characteristic. Where more than five people gave a similar response, these were taken to be relevant characteristics. In the following chapter, the response rate for these characteristics is discussed briefly with a full list of response rates for each exhibit detailed in Appendix D.

Chapter 3

Results

This chapter is divided into two main sections. The first details the results for each of the seven exhibits and includes a brief discussion of the observation and survey data. The second compares the results of the seven exhibits and combines all of the results to provide overall results for Scitech's computer-based exhibits. Further information on each exhibit can be found in Appendix B, Description of Exhibits.

Individual Exhibit Results

For each individual exhibit tables are presented showing the percentages of participants by age and gender and the holding power for each of these population subdivisions.

A - Food For Thought.

Of the 35 visitors observed and surveyed at this exhibit, 80% of the population were female and 20% male. Table 1 shows a further breakdown of this data in terms of age and gender.

Table 1

Percentages of Participants by Age and Gender for Exhibit A

Gender	% Adult	% Secondary	% Primary	Total %
% Female	48 (17)	23 (8)	9 (3)	80 (28)
% Male	11 (4)	6 (2)	3 (1)	20 (7)
Total	59 (21)	29 (10)	12 (4)	100 (35)

The holding power of this exhibit was calculated as 71%. This is the percentage of participants who completed the exhibit out of the 35 participants who used the exhibit.

Table 2 shows the holding power of this exhibit for each division and subdivision of the population according to age and gender. Holding power for these subdivisions was calculated as a percentage of that specific group, ie holding power for adult females was calculated as a percentage of the adult female group. This gives the following calculation:

Adult females completed	=	16
Total adult females	=	17
Holding power	=	(16 / 17) x 100
	=	94 %

Table 2

Holding Power for Population Subdivisions by Age and Gender for Exhibit A

Gender	% Adult	% Secondary	% Primary	Total %
Female	94%	75%	33%	82%
Male	50%	0%	0%	29%
Total	86%	60%	25%	71%

As this table shows, Exhibit A (Food for Thought), has a high holding power for both adult and secondary age females and a lower holding power for the other subdivisions. For subdivisions such as male and female primary, the population is small and results give more information about the attracting power of the exhibit than its holding power.

The average time spent at this exhibit was 4 mins 52 secs with a range from 1 min 14 secs to 8 mins 28 secs. For those people not completing the exhibit, the average time was 2 mins 16 secs and for those who did, 5 mins 55 secs.

On average, female visitors spent more time than male visitors with a time of 5 mins 19 sec compared with 3 mins 3 secs.

The responses from the survey data included 46 positive comments and 30 negative. There were more positive than negative comments probably because this exhibit has a holding power of 71%. This means that more participants were asked what encouraged them to complete, rather than what caused them to leave without completing. Of the positive comments, the following characteristics rated more than five responses each:

- Topic interest - 17
- End result - 12
- Answering questions - 8

These were the characteristics suggested by participants as those they liked most and those that encouraged them to stay to complete the exhibit.

Of the negative comments there was only one that rated five or more responses and that was, "seating", with five responses. This is a comment repeated for most of the exhibits and refers to the wooden boxes provided at the exhibits for visitors.

The main improvements suggested for this exhibit were:

- include more personal feedback at the end (3)
- provide a height measure and scales (4)

- improve the seating (2)

B - Wheezes and Sneezes.

Of the population of participants at this exhibit, 54% were female and 46% male. Table 3 shows a further breakdown of this data in terms of age and gender.

Table 3

Percentages of Participants by Age and Gender for Exhibit B

Gender	% Adult	% Secondary	% Primary	Total %
% Female	29 (10)	14 (5)	11 (4)	54 (19)
% Male	14 (5)	9 (3)	23 (8)	46 (16)
Total	43 (15)	23 (8)	34 (12)	100 (35)

The holding power of this exhibit was calculated as 51%. Table 4 shows the holding power of this exhibit for each division and subdivision of the population according to age and gender.

As this table also shows, Exhibit B (Wheezes and Sneezes), had a higher holding power for both adult and secondary age females and a lower holding power for the other subdivisions.

Table 4

Holding Power for Population Subdivisions by Age and Gender for Exhibit B

Gender	% Adult	% Secondary	% Primary	Total %
Female	80%	60%	25%	63%
Male	40%	33%	25%	31%
Total	66%	50%	25%	51%

The average time spent at this exhibit was 3 mins 12 secs with a range from 56 secs to 6 mins 21 secs. For those people who did not complete the exhibit, the average time was 2 mins 1 secs and for those who did, 4 mins 19 secs.

On average, female visitors spent more time than male visitors with a time of 3 mins 34 sec compared with 2 mins 46 secs.

The positive characteristics suggested by visitors included three with a rating of five or more responses:

- Topic interest - 16
- New information - 10
- Personal relevance - 6

Each of these characteristics is similar and relates to the basic objective of the exhibit, that is to inform people

about asthma and allergies. In Australia, where the incidence of these two is very high, it is likely that a high proportion of visitors will find this topic of interest. It should be noted, however, that the holding power for this exhibit was only 51%. Even though many people thought the topic was interesting, 49% left without completing the exhibit.

The only characteristic that rated five or more responses from the negative list was "visit timing", which received five responses. This refers to the participants' timing and included such factors as; being called away by other family members, moving to the Theatre for a demonstration, leaving to catch a bus, and leaving to be in time for an Omni Theatre session. (An IMAX theatre adjacent to Scitech) Improvements suggested for this exhibit were:

- build a children's version (2)
- improve the seating (3)
- turn it into a game (1)

C - Cell Wars.

The population was made up of 40% female and 60% male. Table 5 shows a further breakdown of this data for age and gender.

Table 5

Percentages of Participants by Age and Gender for Exhibit C

Gender	% Adult	% Secondary	% Primary	Total %
% Female	14 (5)	12 (4)	14 (5)	40 (14)
% Male	11 (4)	20 (7)	29 (19)	60 (21)
Total	25 (9)	32 (11)	43 (15)	100 (35)

The holding power of this exhibit was calculated as 60% Table 6 shows the holding power of this exhibit for each division and subdivision of the population according to age and gender.

Table 6

Holding Power for Population Subdivisions by Age and Gender for Exhibit C

Gender	% Adult	% Secondary	% Primary	Total %
Female	40%	50%	60%	50%
Male	50%	71%	70%	67%
Total	44%	64%	66%	60%

As shown in this table, this exhibit generally has a higher holding power for males than females and in particular with secondary and primary males.

The average time spent at this exhibit was 4 mins 27 secs with a range from 47 secs to 7 mins 22 secs. For those people who did not complete the exhibit, the average time was 2 mins 19 secs and for those who did, 5 mins 51 secs. On average, female visitors spent slightly less time than male visitors with a time of 4 mins 15 sec compared to 4 mins 33 secs.

The positive characteristics that rated five or more responses on this exhibit were:

- End result - 15
- Graphics - 10
- Topic interest - 7
- Enjoyed the game - 5

"End result" was a characteristic that rated quite highly throughout the exhibits and particularly with secondary and primary age males, who stated that they were interested in their end scores in the game type exhibits.

The main negative characteristic suggested was that there was "too much text", with five responses. A related characteristic that received three responses was that some of the text was too small. The main improvements suggested for this exhibit were to shorten it and not to include so much text. Each of these received two responses.

D - Sensing from Space.

Of the 35 visitors observed and surveyed at this exhibit, 37% of the population were female and 63% male. Table 7 shows a further breakdown of this data in terms of age and gender.

Table 7

Percentages of Participants by Age and Gender for Exhibit D

Gender	% Adult	% Secondary	% Primary	Total %
% Female	15 (5)	11 (4)	11 (4)	37 (13)
% Male	23 (8)	23 (8)	17 (6)	63 (22)
Total	38(13)	34 (12)	28 (10)	100 (35)

The holding power of this exhibit was calculated as 23% Table 8 shows the holding power of this exhibit for each division and subdivision of the population according to age and gender.

As this also table shows, Exhibit D has a low holding power for all subdivisions. For subdivisions such as secondary and primary male, the population is very low and gives values only.

Table 8

Holding Power for Population Subdivisions by Age and Gender for Exhibit D

Gender	% Adult	% Secondary	% Primary	Total %
Female	40%	0%	25%	23%
Male	25%	25%	17%	23%
Total	31%	17%	20%	23%

The average time spent at this exhibit was 1 min 58 secs with a range from 21 secs to 5 mins 22 secs. For those people who did not complete the exhibit, the average time was 1 min 10 secs and for those who did, 4 mins 40 secs.

On average, male visitors spent slightly more time than female visitors with a time of 2 mins compared with 1 mins 56 secs.

There was only one positive characteristic receiving five or more responses and that was "topic interest", with eight responses.

This exhibit had a low holding power so there were more negative responses than positive. The main negative

characteristics suggested were:

- Not enough information - 12
- Coloured buttons don't work - 9
- Graphics too slow - 8
- No introduction - 6

The first two and the last of these characteristics seem to be caused by the lack of supporting text for this exhibit. From the analysis of time spent and observation of participants, it was clear that a large proportion of visitors left while the graphic sequence was underway.

It was interesting to note that this was the only exhibit not to rate a response on the seating, even though it is housed in the same way as three other exhibits and has the same seating. This could be because this exhibit had the lowest average time spent on it, so visitors did not generally have time to find the seating uncomfortable.

The suggested improvements for this exhibit related to the negative characteristics with comments such as:

- explain what the buttons do
- speed up the graphics.

E - Flippit.

The population of this exhibit consisted of 37% females and 63% males. A further breakdown is shown in Table 9.

Table 9

Percentages of Participants by Age and Gender for Exhibit E

Gender	% Adult	% Secondary	% Primary	Total %
% Female	9 (3)	11 (4)	17 (6)	37 (13)
% Male	9 (3)	20 (7)	34 (12)	63 (22)
Total	18 (6)	31 (11)	51 (18)	100 (35)

The holding power of this exhibit was calculated as 17%, the lowest of the seven exhibits.

Table 10 shows the holding power of this exhibit for each subdivision of the population according to age and gender.

Table 10

Holding Power for Population Subdivisions by Age and Gender for Exhibit E

Gender	% Adult	% Secondary	% Primary	Total %
Female	33%	0%	33%	23%
Male	0%	14%	17%	13%
Total	17%	9%	22%	17%

As shown in this table, the Flippit exhibit had a very low holding power for all subdivisions

The average time spent at this exhibit was 2 mins 35 secs with a range from 27 secs to 12 mins 32 secs. For those people who did not complete the exhibit, the average time was 1 min 34 secs and those who did, 7 mins 25 secs. On average, female visitors spent slightly less time than male visitors with a time of 2 mins 21 secs compared with 2 mins 41 secs.

This exhibit scored very low on "holding power" and had few positive characteristics with only one rating five responses, that was, "graphics".

Flippit received the highest rating for any single negative characteristic due to its lack of instructions.

- Unclear instructions - 27
- No introduction - 10
- Too difficult - 7

This program had the lowest holding power of the seven exhibits, which from observation of visitors seemed to be because they did not know what to do. When visitors understood the exhibit, they spent quite a long time, ie the longest time spent on any of the exhibits was on this one, at over 12 minutes.

F - Target Shooting.

Of the 35 visitors observed and surveyed at this exhibit, 31% of the population were female and 69% male. Table 11 shows a further breakdown of this data in terms of age and gender.

Table 11

Percentages of Participants by Age and Gender for Exhibit F

Gender	% Adult	% Secondary	% Primary	Total %
% Female	6 (2)	14 (5)	11 (4)	31 (11)
% Male	9 (3)	40 (14)	21 (7)	69 (24)
Total	15 (5)	54 (19)	31 (11)	100 (35)

The holding power of this exhibit was calculated as 77% Table 12 shows the holding power of this exhibit for each division and subdivision of the population according to age and gender. Analysis of table 12 shows that this exhibit has a high holding power for all subdivisions especially adult females. It should be noted however, that only two of the participants were adult females so no generalizations can be made from this data.

The average time spent at this exhibit was 2 mins 59 secs with a range from 47 secs to 6 mins 27 secs. For those people who did not complete the exhibit, the average time

was 1 min 29 secs and for those who did, 3 mins 25 secs.

Table 12

Holding Power for Population Subdivisions by Age and Gender for Exhibit F

Gender	% Adult	% Secondary	% Primary	Total %
Female	100%	60%	80%	72%
Male	67%	86%	71%	79%
Total	80%	78%	73%	77%

On average, female visitors spent slightly less time than male visitors with a time of 2 mins 51 secs compared with 3 mins 2 secs.

The target shooting exhibit scored highest on holding power and rated three positive characteristics as important:

- Using the gun - 23
- Enjoyed the game - 11
- End result - 9

These characteristics all relate to the game nature of this program, as opposed to topic interest which rates quite highly for the other exhibits.

None of the negative characteristics rated five or more responses for this exhibit and the only suggested improvements were to give more shots at the target and make the gun lighter.

G - Scitech Maths Graph.

The population of participants for this exhibit consisted of 34% females and 66% males. Table 13 shows a further breakdown of this data in terms of age and gender.

Table 13

Percentages of Participants by Age and Gender for Exhibit G

Gender	% Adult	% Secondary	% Primary	Total %
% Female	9 (3)	16 (6)	9 (3)	34 (12)
% Male	14 (5)	29 (10)	23 (8)	66 (23)
Total	23 (8)	45 (16)	32 (11)	100 (35)

The holding power of this exhibit was calculated as 51%. Table 14 shows the holding power of this exhibit for each division and subdivision of the population according to age and gender.

As this table also shows, the Scitech Maths Graph exhibit had a high holding power for both male and female adults

and secondary school age females.

Table 14

Holding Power for Population Subdivisions by Age and Gender for Exhibit G

Gender	% Adult	% Secondary	% Primary	Total %
Female	100%	83%	33%	75%
Male	80%	30%	25%	39%
Total	87%	50%	27%	51%

The average time spent at this exhibit was 3 mins 10 secs with a range from 43 secs to 5 mins 21 secs. For those people who did not complete the exhibit, the average time was 1 mins 41 secs and for those who did, 4 mins 34 secs.

On average, female visitors spent more time than male visitors with a time of 4 mins 6 sec compared with 2 mins 40 secs.

Four positive characteristics rated five or more responses for this exhibit:

- Personal relevance - 9
- Topic interest - 6

- End result - 5
- Clear instructions - 5

The only negative characteristic rating five or more responses was, "graphics too slow", which rated nine. This referred to the conclusion of the program when visitors' height and weight statistics are plotted onto a graph.

The two suggested improvements were to speed up the graphing section and to provide height and weight measures next to the exhibit.

Comparative and Combined Results

This section of Chapter 3 has been further divided into five sections. In each section the results from the seven exhibits are compared and combined in order to answer the five subsidiary questions.

In the following tables, the results for each exhibit have been shown with a calculated average, or overall result, for the seven computer-based exhibits.

Subsidiary Question 1.

What is the holding power of each computer-based exhibit?

The overall holding power for the seven computer-based exhibits is 49% which means that only 49% of visitors are completing the programs. The holding power for the individual exhibits can be seen as the exhibits are placed in the following order:

F - Target Shooting	- 77%
A - Food for Thought	- 71%
C - Cell Wars	- 60%
B - Wheezes and Sneezes	- 51%
G - Maths Graph	- 51%
D - Sensing from Space	- 23%
E - Flippit	- 17%

As this shows, there is a large range of 60% for the exhibit holding powers This supports the results from the author's previous study which showed a large range within the exhibits used.

Subsidiary Question 2.

Is visitor age or gender a factor in the holding power of the exhibits?

In order to answer this question, the population breakdowns for visitors using the exhibits were considered before considering the holding power for similar groups.

Table 15 shows the male and female population divisions for the seven exhibits. On average, females were represented 10% less than males. However, the results vary greatly for individual exhibits. In five out of the seven exhibits, the difference was 20% or more. The only exhibits used more by females than males were A (Food for Thought) and B (Wheezes and Sneezes). Both of these exhibits are health related and rated highly in terms of topic interest (see Appendix D)

Table 15

Percentages of Population by Gender for all Exhibits

Gender	A	B	C	D	E	F	G	Combined
% Female	80	54	40	37	37	31	34	45
% Male	20	46	60	63	63	69	66	55
% Total								100

The breakdown of population by age is shown in Table 16. The average percentages are fairly even but again there is a wide range for individual exhibits from 59% adult use at A (Food for Thought), to 12% primary use at the same

exhibit.

Exhibit A (Food for Thought and E (Flippit) have large ranges but opposite maximums with the highest proportion being adults at A and Primary age at E. The exhibit that caters most successfully for all age groups is D (Sensing from Space). However, if that is combined with the information from table 17, it is clear that in fact it scores very poorly for all age groups.

Table 16

Percentages of Population by Age for all Exhibits

Age	A	B	C	D	E	F	G	Combined
% Adult	59	43	25	38	18	15	23	31
% Secondary	29	23	32	34	31	54	45	36
% Primary	12	34	43	28	51	31	32	33
% Total								100

Another point highlighted by table 16, is that the three exhibits with the lowest adult population are E (Flippit), F (Target Shooting) and G (Scitech Maths Graph). They are located in the Maths area in a line and are built at a lower seating level than the other four exhibits. This may indicate to adults that they are for children.

Table 17 shows the holding power breakdown by exhibit and gender. Though the range of holding power varies greatly for individual exhibits, it is interesting to note that female visitors seem to have a higher holding power than males. Even though there are generally less females, they seem more likely to complete the programs. Further research with a controlled population could give a clearer indication of the significance of these results.

This is particularly true for exhibits A (Food for Thought) and B (Wheezes and Sneezes). This may be because these are health-related. This is supported by data in Appendix D, which shows a high visitor response for topic interest for these two.

Table 17

Holding Power Ratings for all Exhibits by Gender

Gender	A	B	C	D	E	F	G	Combined
Female	82%	63%	50%	23%	23%	72%	25%	59%
Male	29%	31%	67%	23%	13%	79%	39%	42%
Overall	71%	51%	60%	23%	17%	77%	51%	49%

Adults seem to have a higher overall holding power than both secondary and primary age visitors in Table 18. This tends to agree with the general opinion held by Scitech

Discovery Staff members, that primary age visitors spend less time at exhibits and are therefore less likely to complete them.

The two exhibits that have high holding power for primary age visitors, are C (Cell Wars) and F (Target Shooting) which are both game style programs. This may indicate a preference for this style of software with younger visitors. Exhibits C and F also had the smallest range of holding powers for different age groups. This may show that the game style is popular with all ages.

Table 18

Holding Power Ratings for all Exhibits by Age

Age	A	B	C	D	E	F	G	Combined
Adult	86%	66%	44%	31%	17%	80%	87%	62%
Secondary	60%	50%	64%	17%	9%	78%	50%	49%
Primary	25%	25%	66%	20%	22%	73%	27%	38%
Overall	71%	51%	60%	23%	17%	77%	51%	49%

Subsidiary question 3.

How long do visitors spend at the exhibits?

The average time spent by visitors on each exhibit is shown in Table 19. This ranges from 1 min 58 secs at D (Sensing from Space), to 4 mins 52 secs at A (Food for Thought). The average time from the combined results is 3 mins 19 secs.

It should be noted that time spent is not always an indication of holding power unless it is considered as a proportion of the average time necessary to complete the exhibit. For example, F (Target Shooting), has a fairly low average time spent but has the highest holding power. This indicates that it is a short, popular program. This trend does not follow with the other exhibits as A (Food for Thought), has the second highest holding power and the highest average time spent. Therefore, program length is not the most important factor affecting holding power.

Table 19

Average Time Spent, in Minutes:Seconds, for each Exhibit

Time	A	B	C	D	E	F	G	Combined
Average	4:52	3:12	4:27	1:58	2:35	2:59	3:10	3:19

Table 20 shows the average time spent by visitors completing and not completing the programs with the combined averages being 5 mins 27 secs for those completing and 1 min 47 secs for those not completing. These results indicate that visitors decide in the first minute or two at an exhibit whether or not they will complete the program.

Table 20

Average Time Spent, in Minutes:Seconds, for each Exhibit showing Completion, or Non-completion.

Time	A	B	C	D	E	F	G	Combined
Completed	5:55	6:19	5:51	4:40	7:25	3:25	4:34	**5:27**
Not comp.	2:16	2:01	2:19	1:10	1:34	1:29	1:41	**1:47**

Time spent by visitors according to gender, varies by almost 30 seconds as shown in table 21. There are however, much greater differences in some exhibits such as A (Food for Thought) and G (Scitech Maths Graph). This supports other results in suggesting that female visitors are more interested in and likely to spend more time at exhibits relating to health and the human body.

Table 21

Average Time Spent, in Minutes:Seconds, by Gender for each Exhibit

Gender	A	B	C	D	E	F	G	Combined
Female	5:19	3:34	4:15	1:56	2:21	2:51	4:06	3:29
Male	3:03	2:46	4:33	2:00	2:43	3:02	2:40	2:58

Table 22 shows the same breakdown according to visitor age. These results echo the holding power results with adults spending more time than both secondary and primary age visitors.

Table 22

Average Time Spent, in Minutes:Seconds, by Age for each Exhibit

Age	A	B	C	D	E	F	G	Combined
Adult	5:17	3:41	4:14	2:17	2:29	2:40	4:23	3:34
Secondary	4:47	3:12	4:27	1:47	2:11	3:11	3:02	3:14
Primary	2:55	2:35	4:43	1 48	2:50	2:42	2:28	2:52

Considering data from the previous four tables, it is not possible to set a minimum or maximum time for programs. However, it is possible to suggest guidelines and in

particular to take age into account when designing the program.

Subsidiary question 4.

Which characteristics of each computer-based exhibit are seen by users to increase their holding power?

The five most highly rated positive characteristics overall were:

- Topic interest - 56
- End result - 44
- Graphics - 32
- Using the gun - 23
- Enjoyed the game - 18

If the characteristic, "using the gun", is placed in a more general category including other input devices and interactions, that category would rate very highly with 31 responses.

One other category that rated only 12 responses but scored on almost every exhibit was that of using a computer. This is a useful rating particularly as there were no negative characteristics about using computers.

These ratings show that the choice of topic is perceived by visitors to be the single most important characteristic in the exhibit.

Subsidiary question 5.

What characteristics of each computer-based exhibit are seen by users to decrease their holding power?

The five negative characteristics that scored most highly were:

- Unclear instructions - 30
- Visit timing - 21
- Seating - 19
- Graphics too slow - 17
- Not enough information - 17

It is useful to note that the characteristic with the highest negative rating, received 27 of those responses from Exhibit E (Flippit). That indicates that generally visitors were happy with instructions, however the ratings from Exhibit D (Sensing from Space), indicate that further information and introduction is also required at that exhibit.

The two exhibits with the lowest holding power received many negative responses for instructions, graphics and information. These were D (Sensing from Space) and E (Flippit).

The main finding from this combination of results is that with the exception of visit timing, it should be relatively easy to respond to these negative characteristics which generally relate to method of presentation.

These results validate the visitor responses because the characteristics which they feel are important in holding them at exhibits, are missing at the exhibits with low holding power. Similarly, the exhibits with high holding power have a high rating for those exhibits rated most highly by visitors.

Visit timing, as a negative characteristic, provides little criticism of the exhibits, but needs to be taken into account when deciding on the length of new programs. Visitors generally wish to see as much of the Centre as possible in one visit and it may be difficult to hold them at one exhibit for any extended length of time.

Chapter 4

Conclusions

This chapter discusses the results detailed in the previous chapter and uses them to answer the main research question and make recommendations for Scitech Discovery Centre.

Research Question

The overall research question studied by the author was:

Which characteristics of computer-based exhibits determine their holding power for general public visitors?

This question was answered by considering the data collected by observation and survey. Other factors that became evident during the study were also considered.

Rated Characteristics

As discussed in the previous chapter, the results have identified a number of important factors to consider. Appendix D lists and rates 17 positive characteristics and 23 negative characteristics. To these must be added others, in particular, age and gender which have been shown to

affect holding power and time spent for all exhibits. The identified positive and negative characteristics can be further classified into internal and external characteristics. As defined in chapter 1, those that occur within the exhibit are termed internal. External factors are those that occur as physical features of the Centre or factors that visitors bring to bear.

The internal characteristics identified as most significant were those that rated ten or more responses. They are discussed in order of significance.

The highest rated single characteristic was, "end result", with 44 responses. This was spread across the exhibits which provide an end result or score. The next highest was "graphics", with a positive rating of 32 and a negative rating or 17. This shows up as a major factor in both lists.

"Clear instructions" is another vital characteristic. This rated 30 on the negative list and 12 on the positive. The fourth rated characteristic was specific to Target Shooting and was, "using the gun". This could be combined with other similar characteristics such as, "using the joystick", and be considered as input devices.

No visitors suggested a feeling of intimidation about the computers or input devices, so these seemed to work for those visitors using the exhibits. However, it should be considered that visitors feeling intimidated by such exhibits may simply avoid them.

The next rated characteristic was, "enjoyed the game", with a positive rating of 18. This could be argued to be personal interest and therefore an external characteristic. However, it was considered a factor of software design and as such is internal.

It should also be noted that males found the game type exhibit more interesting as evidenced by the holding power of exhibits such as Cell Wars and Target Shooting. Previous research shows that males enjoy competitive learning environments whereas females do not. This may well be a fastor which needs to be considered in software design.

The last three characteristics were, "not enough information", "too difficult" and "too much text". These three in particular should be considered in relation to the audience for the exhibit.

The highest rating external characteristic was "topic interest", which was considered external because it is the visitor's interest that engages them at the exhibit.

Because this was the highest of any rated characteristics, it should be considered at the design stage of any computer-based exhibit.

The next characteristic rating was, "visit timing", which is a factor difficult to influence within the Centre. Seating was the third rated, with 19 negative responses. These related to both the height and style of seating.

These external and internal characteristics were not consistent for all exhibits but can be used as guidelines to consider for current exhibit modifications and new exhibit designs.

Interaction level.

Considering the interaction level of the exhibits, raises other factors that may be relevant; those of software design and level of interaction. Within this study there were; (a) game type programs, requiring high levels of interaction; (b) question based programs, requiring medium interaction; and (c) information programs requiring minimum levels of interaction.

The following identifies each of the exhibits in holding power order with type and interaction level.

- F (Target Shooting) is a game type with high interaction.
- A (Food for Thought) is a question type with medium interaction.
- C (Cell Wars) is a game type with high interaction.
- B (Wheezes and Sneezes) is information type with low interaction.
- G (Maths Graph) is a question type with medium interaction.
- D (Sensing from Space) is an information type with low interaction.
- E (Flippit) is a game type with high interaction.

From this it was difficult to observe any pattern. However, if Flippit had clear instructions for visitors, it may have had a much higher holding power. This seems to plac the game style programs as the highest for holding power. This supported the data analysis in chapter 2 showing the two exhibits with the closest holding powers for all age groups as the two game style exhibits. Further research is necessary to determine if interaction level is a significant factor.

Length.

Length of the program was rated as a negative characteristic with only nine responses from the survey data and therefore can not be seen as the most important factor. This suggests that apart from exhibit D and G,

where specific comments were made about graphic sequences, that the program lengths were quite appropriate.

It should be noted however, that the average time for people completing the programs was 5 mins and 27 secs, and for those not completing, 1 min 47 secs. This indicates that if a topic is of interest, visitors will be happy to spend 5-6 mins to complete a program. On the other hand, if visitors are not interested, they will leave in the first 2 mins. This provides a general guideline for exhibit designers to create programs that visitors can complete in 6 mins and include interesting actions and information within the first 2 mins.

Age and gender.

Age and gender have been shown as other important factors affecting exhibit holding power. Overall, males and females vary in holding power by 17%, however, the difference in specific exhibits is as much as 69%. This trend also occurs in the age of participants and holding power, with an overall difference of 24% but a difference of 77% within the exhibits.

This indicates that Scitech is close to reaching its aim to cater for all ages and both genders but it is not achieving that aim for individual exhibits. This raises a policy

issue that needs to be considered by the Scitech staff. Should all exhibits be aimed at the widest audience or should there be a set audience in mind when designing exhibits, computer-based or otherwise?

If the Centre chooses to design the computer-based exhibits for specific age groups, the results in chapter 3 should be used as guidelines for program length and style. The physical proportions of the exhibit should also be considered. Two comments from participants indicated they thought that the three exhibits in the Maths Sum Fun area, were built at a lower height specifically for children. This was not identified by any other visitors, but may account for age differences in participants at the lower exhibits as opposed to the upright "Tardis" models.

Location.

Another important factor that was not suggested by visitors but became obvious during the observations, is that of exhibit location. In particular, the holding power of the three exhibits in the Maths area, Flippit, Target Shooting and Maths Graph, was affected by their proximity to each other. Many of the participants, in particular primary and secondary aged males, moved from one to the other of these three exhibits as they are in a line next to each other. It became clear that Target Shooting was the most popular of the three and that some visitors would sit and use the

other two until Target Shooting was free.

Another consideration is the proximity to other distracting exhibits or activities. This was noticed at Food for Thought where a number of visitors left without completing the program as they saw a group of visitors moving into the Theatre for a demonstration.

This discussion of characteristics shows clearly that there are overall characteristics that apply to most exhibits. This study suggests that these be used to make modifications to existing exhibits and as guidelins for the development of new exhibits.

Research Limitations and Modifications

There were a number of modifications suggested to improve this study, the main one being the validity of participants' responses in an "on the spot" situation. Visitors may not have felt comfortable criticizing the Centre's exhibits even to a person perceived as an outsider. They may also have been unaware of the characteristics with which they were satisfied, as they would probably come to expect fairly high standards in exhibit design.

If this study were to be repeated to gain further information about this research question, the author would suggest some changes. A major change would be to include a more structured survey or questionnaire in the data collection.

Now that certain characteristics have been identified, it would be useful to ask visitors to rate the exhibits on those characteristics. This could include timing, screen design and level of interaction. This could either replace or add to the current survey to provide more information.

Recommendations

From this study it is possible to make some recommendations for immediate and long term consideration by Scitech staff. The immediate recommendations should improve those existing exhibits while the long term recommendations should provide information for the design of new computer-based exhibits.

Immediate recommendations.

These recommendations were made on the basis of visitors' suggested improvements and responses from the survey.

(a) Provide comfortable seating for all computer-based exhibits taking into account the height of the exhibit and

visitor height ranges.

(b) Provide height and weight measures next to Food for Thought and Scitech Maths Graph.

(c) Provide clear instructions for the Flippit exhibit. If it is not possible to provide these on screen, a graphic panel on the exhibit stand, or right next to it, would be desirable.

(d) Add an introduction and further information for Sensing from Space. This should include an explanation of what is seen, how the image is generated and what is highlighted when the coloured buttons are pressed.

(e) Speed up the graphic sequences in Sensing from Space and Scitech Maths Graph if possible.

Long Term Recommendations

Scitech Discovery Centre needs to make some policy decisions about the computer-based exhibits and consider the following questions before the design process starts.

(a) Is a computer-based exhibit the most effective way to involve visitors in the chosen topic?

(b) Is the topic of interest to visitors?

(c) What is the audience for the exhibit? Should it appeal to all visitors or to a specific group?

A number of these questions can be answered by involving members of the general public in the decision-making process before the design stage is reached. Once these

policy-type questions have been considered and decisions made, the factors and characteristics discussed in the previous section should be considered at the start of the design process and allowances made for on-going modifications when required.

The final recommendation is that, whenever possible, the computer-based exhibits are trialled with visitors before they become permanent exhibits.

Future Research

The next most appropriate research to consider would be to implement the recommendations stated previously in this chapter and repeat this study. This would determine if the characteristics suggested by users are the ones that determine holding power. This study could be achieved using Scitech's volunteer SciGuides to collect unobtrusive observation data and would not need the survey section.

As an addition to this research, it would be useful to consider the attracting power of the computer-based exhibits, that is, the percentage of people that use the exhibits of the number of people that walk past. To ensure the usefulness of these results, they should be compare to similar results from other exhibit types.

To take this research to the next logical stage would be to study how much visitors learn from these computer-based exhibits. This should include a comparison of population groups as a factor in the learning that takes place. This study would be a useful complement to the MASTEC study (Dymond, Goodrum & Kerr, 1990) as it would concentrate on visitors in a free choice visit, rather than controlled small groups using selected exhibits.

A further step in this long term evaluation of computer-based exhibits would be to compare the effectiveness of computer-based exhibits to other exhibit types. This should take into account the level of interaction of the other exhibits and could involve comparisons between computer-based and non-computer based exhibits with the same objectives. This could also consider the attracting power, holding power and learning as a result of exhibit usage.

A more specific evaluation of software type could consider the holding power and learning that occurs for different styles of software. This should consider levels of interaction and end results.

Though this study has provided some guidelines and recommendations for Scitech staff and staff at other science centres, it has also raised some important

questions. These questions should become part of an on-going evaluation plan within the Centre in order to ensure that Scitech continues to meet the needs of its visitors into the future.

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Appendix A

Further information on Scitech Discovery Centre

Mission Statement

To increase interest in science and modern technology as they affect our lives.

Broad Objectives:

(a) To present science and modern technology in ways which are interesting to the general public.

(b) To complement formal education programs.

(c) To encourage young people to consider careers in science and technology.

(d) To be relevant to industry, and Western Australia.

(e) To promote responsibility in the application of science and technology to the service of society.

Broad strategies for each of the objectives:

(a) By developing exhibits and programs which are exciting, engaging and educational for the general public, and students, and by being marketing and visitor oriented

in all functions.

(b) By promoting Scitech to schools, and assisting teachers to make the most effective use of Scitech.

(c) By promoting to students, careers in science and technology.

(d) By liaising with industry, and promoting areas of relevance to industry and Western Australia, in exhibits and programs.

(e) By espousing excellence, integrity and social values in all of Scitech's activities.

Theme areas

Scitech contains ten theme areas that include exhibits relating to most of the science disciplines. Theme areas are inter-disciplinary so that visitors will be involved in a variety of activities during their visits. Many of the theme areas and exhibits are inter-related and lend themselves to activities in a wide range of subjects.

Each theme area has its own subtle colour coding to make identification easier as the theme areas are not clearly

separated by physical divisions.

Theme areas currently are:

Sight and Light

Sound and Sensing

Earth's Resources

Genetics

Motion and Transport

Materials

Energy

Communications

Rhythms

Sum Fun (Maths area)

Staffing

The Centre currently employs approximately 25 full time equivalent staff working in the three following areas;

(a) Science and Education

(b) Marketing and Public Relations

(c) Exhibit Production and Maintenance

Other Research in the Centre

A variety of informal evaluation has been carried out by Scitech education staff on exhibits, education programs and exhibit graphics.

A formal evaluation research project has just been completed by outside consultants in conjunction with the science and education team. Three consultants from WACAE's MASTEC group carried out and reported on a study to determine characteristics of educationally successful exhibits. (Dymond, Goodrum & Kerr, 1990)

The consultants concluded that "students in the study made significant gains in their understanding of science". They further concluded that "there is no single characteristic of exhibits which affects consistently either the cognitive gain or preference rating of students".

This initial evaluation is part of a proposed five year evaluation plan incorporating exhibits, programs and graphics. This author's research on computer-based exhibits provides a useful component of the long term plan involving evaluation of a specific group of exhibits.

Appendix B

Description of Exhibits

Food for thought.

The objective of this exhibit is to make people more aware of their food intake and the changes necessary for a balanced diet. Visitors input information using a joystick and a single button.

The program begins by asking visitors to input their name, age, height and weight. It then asks visitors a series of questions about their diet. The questions relate to type and amount of food intake and require visitors to choose one of four options. At the end of the program the visitor is given a score out of eighty and some information regarding possible positive changes in their diet.

Wheezes and sneezes.

This exhibit aims to provide information about asthma and allergies to both sufferers and non-sufferers. It is an information program that works through stages covering the causes, treatment and ongoing prevention of the two conditions.

The instructions are short and simple with several colourful graphic sequences. Visitors move through the program at their own pace using a joystick and button.

Cell wars.

This program is designed to involve visitors in a space invader type of game simulating the body's fight against infection. It simulates a splinter piercing the skin and allowing germs to enter. The visitor becomes various parts of the body's immune system and helps to fight off the invaders.

The visitor's score can be boosted by correctly answering questions during the program. Visitors control the software using a joystick and a single button.

Sensing from space.

Sensing from Space is a software package developed by a scientist from CSIRO and modified to run in the centre. It involves visitors in viewing remote sensing satellite pictures of Perth and surrounding suburbs.

Visitors use a joystick and 4 buttons to select an area and enlarge it. They can then highlight parks, housing and

rivers using the coloured buttons.

Flippit.

Flippit is a software package that challenges visitors to modify a given pattern of sixteen squares to match another given pattern. The aim is to find the axis of symmetry and flip the patterns until they match.

Visitors work through varying difficulty levels and use a joystick and button to control the software.

Target shooting.

This exhibit aims to explain the difference between the chaotic and stable rule in statistics. Visitors use a gun to shoot at the screen and choose from options as they appear on screen.

The chaotic rule option involves visitors in shooting at a target and correcting their aim after each shot. The stable rule option encourages visitors to shoot steadily at the target and then correct their aim after the first set of ten shots.

Scitech maths graph.

Visitors work through a series of simple information gathering activities that provide information to be displayed in a graph format.

The program works through pie graphs, column graphs, line graphs and scatter graphs. Visitors use a partially covered keyboard to input information.

Appendix C

Data recording instrument

1. OBSERVATION INSTRUMENT

EXHIBIT: _____

DATE: _____

SEX: M F

AGE: Prim Sec Adult

COMPLETED: Y N

TIME SPENT: _____

2. SURVEY INSTRUMENT

1. What did you like about this exhibit?

2. Is there anything you didn't like about the exhibit?

3. What encouraged you to keep going 'till you finished?

or

4. What stopped you from finishing the program?

5. What could we do to improve this exhibit?

Appendix D

Characteristic Response Tables

Table 23

Response Rates for Positive Characteristics from Survey Data for all Exhibits

Characteristics	A	B	C	D	E	F	G	Total
Topic interest	17	16	7	8	0	2	6	56
End result	12	0	15	0	3	9	5	44
Graphics	2	4	10	4	5	4	3	32
Using the gun	0	0	0	0	0	23	0	23
Enjoyed the game	0	0	5	0	2	11	0	18
Personal relevance	0	6	0	3	0	0	9	18
Using a computer	2	1	0	2	3	1	4	12
Clear instructions	0	0	4	0	0	3	5	12
New information	0	10	0	0	0	0	1	11
Answering questions	8	0	0	0	0	0	2	10
School topic	2	0	3	2	3	0	0	10
Interaction	2	0	0	0	2	0	4	8
Better than reading	1	2	2	0	0	0	1	6
Work at own pace	0	1	0	1	1	0	0	3
Using a joystick	0	0	1	0	2	0	0	3
Everything good	0	1	0	2	0	0	0	3
Good for all ages	0	0	1	0	0	0	0	1
No response	14	11	8	21	20	9	13	96

Table 24

Response Rates for Negative Characteristics from Survey Data for all Exhibits

Characteristics	A	B	C	D	E	F	G	Total
Unclear instructs	0	0	1	0	27	2	0	30
Visit timing	3	5	1	3	2	4	3	21
Seating	5	2	3	0	3	4	2	19
Not enough info	3	2	0	12	0	0	0	17
Graphics too slow	0	0	0	8	0	0	9	17
No introduction	0	0	0	6	10	0	0	16
Too difficult	1	1	1	0	7	3	0	13
Going to other exhibits	4	2	0	4	0	0	2	12
Too much text	0	2	6	0	0	0	4	12
No topic interest	1	3	0	0	0	2	3	9
Too long	2	1	2	0	0	0	4	9
Buttons don't work	0	0	0	9	0	0	0	9
Too many questions	3	0	4	0	0	0	1	8
Not my age level	0	2	0	0	0	4	2	8
Text too small	0	2	6	0	0	0	4	12
Joystick too slow	2	0	2	3	0	0	0	7
Boring	0	1	0	3	0	0	2	6
Joystick too fast	0	0	1	0	5	0	0	6
No feedback	0	0	4	0	0	0	0	4
Text too small	0	0	3	0	0	0	0	3
Joystick does nothing	0	3	0	0	0	0	0	3
Repetitive	2	0	0	0	0	0	0	2
Exhibit too high	2	0	0	0	0	0	0	2
No response	15	25	21	14	10	24	18	127