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USE OF PROPOSED TECHNOLOGIES AT THE WORCESTER ECOTARIUM

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Abstract

The objective of this project was to develop effective ways for the EcoTarium in Worcester to use its new Telecommunications Theater. This report discusses ideas we formulated or expanded upon to make use of the facility and its technologically advanced capabilities. Our most important ideas revolved around the usage of digital cameras by patrons and staff, with the Telecommunications Theater as a means to combine the new technology with existing presentation practices.

Acknowledgements

Throughout the course of our IQP, there were a number of people we came in contact with who helped us out tremendously. First, we would like to thank the entire EcoTarium staff for their valuable assistance throughout our time there. In particular, Mike Nelson, an ecology specialist at the ET was extremely helpful and gave us a lot of his time. His input gave us several unique ideas that we otherwise might not have thought of. He also gave us several interesting uses for digital cameras.

Catherine Dawson, Manager of School Partnerships & Professional Development at the ET until May 2000, also contributed a great deal to our project. As one of our contacts at the ET, she helped us get access to the busy ET staff members and helped us find answers to many of our questions. We'd also like to thank Dr. Dolores Root, the Director of Museum Programs and Exhibits at the ET, for giving us an opportunity to be involved in this interesting project. Jesse Anderson, the Senior Design Engineer at the ET, was also very helpful, providing us with detailed information about the Telecommunications Theater that was integral to our endeavor.

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Attribution Statement: The three members of this project team contributed equally to each section of this report.

Chapter 1: Introduction

Within the museum community there are certain institutions that focus on delivering "hands-on," dynamic presentations to its patrons in an effort to facilitate their learning. These institutions, known as science centers, are a completely unique entity, with very few practical similarities to their "traditional" museum counterparts. Their goal has always been to educate people of all ages in the areas of science and the environment. "Science centers provide a whole new field of self-motivating experiences in learning, through environmental exhibits that appeal to the senses, emotions, and intellect".[1] By appealing to several completely different facets of a person's psyche, science centers make their exhibits entirely different from anything found elsewhere. By interacting with exhibits, instead of merely observing them as one would do in a traditional sort of museum, a visitor has a much better chance of understanding the concepts involved. As Confucius said, "I hear and I forget. I see and I remember. I do and I understand".

The future of today's society lies in the minds of its children. Because of this, the way children learn has an important impact on the direction society as a whole is taking. Science centers have evolved to provide children with a unique form of education they cannot find in school or at a traditional type of museum. While the education provided by a science center cannot replace that which is provided in school, it can still be an important part of a child's educational experience. Science centers try to get children to think about applying information they learn in school to their lives and the world around them.

Because of this, the education they provide has a much farther-reaching influence on children than does classroom learning. The EcoTarium in Worcester, MA, is an excellent example of how this type of institution organizes itself to educate children in this capacity. Many exhibits at the EcoTarium are designed to teach children how their actions have consequences, and how those consequences change both the environment and the people around them. While many science centers provide this type of education, the EcoTarium's focus on the environment has made them a somewhat unique institution. In a time of numerous environmental concerns, both for us and for our children, "the EcoTarium is the only museum in New England solely dedicated to environmental education."[2]

The EcoTarium is moving to improve on its existing facilities. In October, 1999, we were made aware of the EcoTarium's plan to build a technologically advanced auditorium called the Telecommunications Theater. The facility's primary use is for staff to give presentations to visiting patrons; however, it was also designed to accommodate a multitude of different functions, such as science fairs and teacher workshops. Our project focused on the ways the Telecommunications Theater could best be used to both aid in the education of children as well bring families a unique experience when visiting the ET. With the aid of many conversations with EcoTarium staff, we were able to develop several approaches that we felt best addressed the need for a more multi-sensory approach in its presentations.

The Telecommunications Theater has advanced audio and video capabilities that will enhance a patron's experience at the EcoTarium. The problem was how to utilize the Theater to the best of its design. Based on our conversations with EcoTarium staff, we developed some possible ways that the advancements in audio and video would help visiting groups learn the presented material in a way that is different from the traditional lectures that staff members had been giving. From this information, we were able to make our recommendations.

This report documents our ideas for utilizing the capabilities of the new Telecommunications Theater at the EcoTarium to provide students with a more multi-sensory experience. We begin with a brief background about what makes a science center and how this differs from a museum. We follow with a discussion of our ideas for how the EcoTarium can better utilize the new Telecommunications Theater in order to give students a more comprehensive experience. In doing this we explain how we feel the EcoTarium can use audio, in addition to the still images they currently have to enhance the user experience of their presentations. We also provide an explanation of "bug-bots" – small, remote-controllable cameras that can be placed in animal tanks – and how we envision they can be used to provide presentations with live, interactive video. Additionally, we present an idea for how the EcoTarium can better incorporate existing audio, video and still images into their presentations by maintaining an editable, searchable database of all forms of multimedia. We conclude the discussion of our ideas by introducing digital cameras and how we feel they can

give students and visitors a totally new type of experience when visiting the EcoTarium. The conclusion to the report details our experiences over the past six months. It explains the steps we took, and the numerous options we explored while we investigated our IQP. We conclude with a brief mention of the things that, in hindsight, we would do differently. This is included to provide some introspection of the things we have done and how, through our mistakes, we in fact have learned a great deal.

Chapter 2: Background

Role of technology in education

In today's society, emerging technologies are changing the worlds of business and entertainment. They also have a profound effect on the face of education as well. Studies show that students who use computers in school demonstrate improved motivation, enthusiasm for school, capacity for critical thinking, problem solving, independent learning, and the ability to compete in the workforce.[3] New technologies, when used in the classroom, have the added advantage of appealing to a student's interest and attention, as well as advancing cognitive skills. It also allows teachers to demonstrate certain concepts that may be difficult to visualize. A study done in conjunction with Educational Testing Services in 1998 showed that eighth grade students scored higher on the National Assessment of Educational Progress when their teachers utilize technologies for simulations and applications in the classroom.[4]

Another helpful aspect of the new technologies is increased interaction. Through the use of cameras and projection equipment, the smallest specimen or demonstration can easily be seen by a large group of students. This is much more effective than trying to crowd many students around a single demonstration on a small table. The use of zoom capabilities and digital enhancing can also allow students to observe minute details and aspects of a specimen that the naked eye might not be able to distinguish unassisted. By involving more students in the educational experience, these technologies enhance the effectiveness of the demonstration. Furthermore, if students utilize these

capabilities to share their ideas with others, then the students gain a hands-on experience, technical literacy of the equipment, and possibly a pride of accomplishment for their work. Hands-on experience is one of the best ways to learn and retain new material, and technical literacy is a very important factor in today's workplace. The use of technologies in educational environments give students an advantage, not only for the present, but the future as well, because it is not limited merely to the material they are taught, but helps to build skills which are important later in life.

Role of science centers in education

In order to comprehend the integral connection between science centers, education, and society, it is first necessary to better understand what science centers are. A science center is based around the idea of patrons interacting with exhibits – they learn by experience, rather than by simply having information presented to them. This is the key difference between a science museum and a science center. Museums are typically defined by collections of objects, where a science center tends to be centered on interactive exhibits. An Educational Facilities Laboratories report describes the stereotypical museum saying:

> Docents led school children through the museum's halls with occasional admonishments to be quiet and orderly. On weekends, families arrived, the parents pulling kids along to expose them to a genuine cultural experience.[5]

It goes on to discuss the superiority of interactive, exhibit-based, and experience-oriented museums, which have become known as science centers. An interactive approach is not only more educational, but it has a greater ability

to interest visitors and that is beneficial to the institution as well as the visitor. The report details the educational advantages, saying:

> The visitor can learn the most through an experience in which he is an active participant. Such participation may take the form of touching artifacts or live animals, trying out an experiment, measuring your own pulse rate, going on a fossil dig, or playing a game with the computer.[6]

The role of collections is also a defining characteristic of the uniqueness of science centers. Museums revolve around their collections, whether they are paintings, artistic treasures, artifacts, or specimens. The maintenance and possession of these collections is the primary function of the traditional museum. Science centers may also possess collections, but these collections are supplemental to the primary purpose of the centers. Science centers create educational programs and exhibits around the items in their collections.[7] Therefore, science centers tend to operate with smaller collections, and little or no curatorial staff. The educational exhibits are also more effective for the communication of concepts and ideas, a factor that traditional museums and collections often have difficulty carrying out. Science centers accomplish this effect by using interactive exhibits that are designed around a small number of objects or artifacts, choosing to focus on understanding rather than presentation. These characteristics make science centers both enlightening and entertaining, and they have a stronger educational value than traditional museums. They provide an environment where patrons can learn at their own pace.

Chapter 3: The EcoTarium

Mission of the EcoTarium

The EcoTarium (ET), formerly the New England Science Center, is a not-for-profit organization that deals exclusively with environmental issues and education. "The mission of the EcoTarium is to promote appreciation, increase knowledge and foster stewardship of our New England environment by stimulating learning about the world in which we live."[8] It is quite a unique establishment, being the only one of its kind in the New England region. A pamphlet published by the EcoTarium has this to say:

> The EcoTarium is the only museum in New England that is solely dedicated to environmental education. Using exhibits, experimental programs and state-of-the-art computer technologies, we investigate New England habitats, the stars and sky above us, the unseen world of microorganisms and the many ways our local landscape is connected to regional and global processes.[9]

The tools noted in the above quote are used to educate ET patrons about the New England environment. Through the use of interactive exhibits and programs in conjunction with advanced computer technologies, the ET provides a stimulating learning atmosphere. The focus on local environmental education allows staff to point out distinctive features of the New England area while on nature walks around the ET grounds, and gives staff the opportunity to explain how these features are unique. In this way, patrons think about the things that are in their own back yards in a way that they have not thought about before. The ET gives people the ability to see their own habitat in a different light.

The Telecommunications Theater - A Link Between Technology, Science Centers and Education

Over the past several years, everyone from businesses to public schools have been updating their organizations to make better use of technology. As schools and other science museums began integrating exciting new technology into their educational programs, the ET had to keep up. In the early part of the last decade, a major innovation in the link between education and technology was created in the JASON Project. Founded by oceanographer Dr. Robert Ballard, the man who discovered the wreck of the Titanic, the JASON Project is described as "a year-round scientific expedition designed to excite and engage students in science and technology and to motivate and provide professional development for teachers."[10]

The key to the JASON Project was its utilization of technology and telecommunications to bring students on a journey they could never actually go on themselves. The JASON Project required participating institutions to have satellite download capabilities as well as the facilities to display both audio and video to a large audience. The ET, in an attempt to participate in the Project, used money procured through grants from the National Oceanic & Atmospheric Administration (NOAA) to purchase a satellite dish and to build a room large enough to house the students viewing the JASON Project's programs (See Appendix A). This room, however well suited for its purpose, did not fully meet the needs of the ET staff for giving presentations not related to the JASON Project. In an attempt to meet these needs, the ET began to undertake the

construction of the *Telecommunications Theater*, a room with ample space and such wide ranging capabilities as to allow staff members full freedom over the nature of their presentations.

The ET staff began working several years ago with architects and audio/video (A/V) contractors to design the Telecommunications Theater. The space they designed has succeeded in becoming a technologically advanced, user-friendly, and versatile presentation room well suited for a variety of applications. Although it was originally designed as a large space for staff members to give presentations to visiting students, many more uses – for example as a presentation room for corporate functions – have presented themselves to the EcoTarium staff.

Capabilities of the Telecommunications Theater

The Telecommunications Theater is a highly versatile, technologically advanced auditorium, capable of accommodating groups of up to 225 people. The seating area consists of retractable platforms, so it can be adapted if more floor space or fewer seats are needed. The platforms can be fully retracted, opening up the entire floor for tables or whatever else might be needed. This allows the room to be more than an auditorium; it can also be a function room for business meetings, professional presentations, science fairs, or private occasions. The theater is also appropriately wheelchair accessible.

But even more impressive than its physical aspects is the flexibility of its technical systems. The front wall of the Telecommunications Theater is divided into three areas, each corresponding to the display area for one of the theater's

three projectors. All three projectors can display images or video from the theater's laserdisc, DVD (Digital Video Disc), CD, or S-VHS (Super Video Home System) players and TV tuner, as well as video inputs from the jacks distributed about the room, such as video cameras or video microscopes. In addition, the center projector is data projection capable. It can display images and data from the Apple G3 computer in the control room. The front wall is also equipped with closed caption display boards to accommodate patrons with hearing difficulties.

The audio system is similarly configured for flexibility. The remarkably flexible, high fidelity speaker arrays within the theater can accept the audio input associated with the video sources, as well as the cassette player, AM/FM tuner, G3 computer and microphones. The theater is also equipped with a hearing assist system for those patrons who require it.

Although this technology may seem daunting to the most seasoned presenter, the theater truly excels in ease of use. All of the video source and projection, audio and volume, and lighting controls are accessible through the Crestron remote control system. Utilizing touch screen monitors in the speaker's podium or control room, a presenter is able to make selections from easy-to-understand menus to operate the equipment. For example, to select video from the DVD player to be projected on the left area of the front wall, a presenter would only need to select the display menu for the left projector and choose the DVD player from its menu. The equipment controls are also accessible from the screen. This makes it possible for one person to control all aspects of a presentation from the podium without difficulty.

Limitations of Current Presentations and The Multi-Sensory Approach

Currently, the ET staff is limited in the types of presentations it can provide to its visitors. Current presentations primarily use whiteboards or chalkboards for making drawings or writing notes, but the writings and drawings are small and not easily visible to all of the visitors who are viewing the presentation. Another major drawback for current presentations is the lack of quality audio to go with the visual aids that a staff member displays. Audio is used very infrequently in ET presentations, but when it is used it comes mainly from the front of the room, and people in the back have trouble hearing it clearly. Video is also a concern for ET staff. At this point, they have a laserdisc player hooked to a television, but the problem with this setup is that even a very large television can be hard to see from relatively short distances away. For example, when showing images from a video microscope, people in the back tend to miss what is being presented to them, because the images are so small. The Telecommunications Theater fixes many of the physical problems associated with displaying the media better, but the exact nature of that media still needs to be defined.

The major theme that came out of our many conversations with the ET staff was the need for presentations to cater to all the senses. That is, instead of just a visually stimulating approach, the presentations should be geared in such a manner as to appeal to as many of the five senses as possible. This makes a presentation more memorable to the viewer, since one sense does not get over stimulated. Varying the stimulus, especially for younger audiences, will keep the

viewers' attention, and the things that are presented will be more apt to be retained in memory.

The following sections contain what we believe to be several effective ways for the ET to provide a more multi-sensory experience for its many visitors. In these sections, we have expanded upon several ideas presented to us by several ET staff members. We cannot take credit for their ideas for incorporating an improved audio system in presentations; for the use of miniature cameras (called "bug-bots") to show an animal in its natural habitat; and for the design of a database to store the digital images and sound clips. The imaginative people working at the ET conceived these ideas in their most basic form and shared them with us. Our contribution was to take them and follow them through as far we could so as to create a solid, well-formed proposal. The idea for the ET to introduce digital cameras for use by students, staff, and families that visit the ET is in contrast ours alone. We feel that with these four ideas coupled with the extensive technological resources afforded by the Telecommunications Theater, the ET can provide the multimedia experience necessary to keep today's younger generation (often referred to as the "MTV Generation"), as well as adults interested in environmental education.

Chapter 4: Achieving a Multi-Sensory Presentation

Audio

There are many other aspects to environmental education that cannot be conveyed through visual means alone. The sound of a bird chirping, or of a cricket's mating call are elements that any current presentation at the ET cannot demonstrate. For this ability, a complete audio component must be incorporated into presentations when they are moved into the Telecommunications Theater.

According to ET staff members, one of the biggest things they would like to be able to do with audio is to place a microphone on or near an animal so an entire class could hear the animal's sound. One of the biggest problems with a large class viewing one presentation, with one presenter standing in the front of the room, is that the people in the back cannot usually hear sounds made by something the presenter is doing or showing. By taking the quiet sounds an animal makes and amplifying them, everyone can get involved in the presentation. In order for this to work correctly, the presentation area must have easily accessible microphones that are wired directly into the speakers in the room. The Telecommunications Theater at the ET, because of its robust design, provides these microphones to the presenter so as to make this type of audio work possible.

Another key component in integrating audio into presentations is that the manipulation and reconfiguration of the microphones must be a simple task. Staff members should be able to switch from any audio source to any of the microphones at the press of a button. This is the beauty of the Crestron system

being used by the ET in the Telecommunications Theater. It should provide staff members an extremely simple and straightforward way to configure audio sources. In this way, staff members doing presentations can quickly switch between the sound coming from a VCR, computer or laserdisc, and the sound coming from the microphone for an animal.

Another key feature that a successful presentation space should have is a one-touch way to record the audio source to a cassette tape or a computer file; functionality already incorporated into the Telecommunications Theater. In this way, staff members can save interesting pieces of audio for play during a later presentation. This allows them the freedom of not always bringing animals into a presentation just for one single sound. Imagine, for example, that the ET is doing a presentation on birds. They do not necessarily want to bring every bird they have on their grounds into the presentation. If, however, they have already recorded sounds from many of them during a previous presentation – or during a separate "recording session" – they could get access to every bird's calls without the need to actually bring the birds in.

Bug-bots

Another idea proposed by ET staff members was to place small, remote-controllable video cameras in the animal tanks located inside the ET. These small cameras, called "bug-bots," would allow a presenter to view the life of an animal, such as a turtle or a fish, from a remote location. These cameras, because they are remote-controllable, can be rotated or zoomed with out having to physically touch the camera. This allows someone operating one of these

cameras the freedom of being able to find an animal in its tank, wherever it may be hiding.

Tying these bug-bots into the video system of the Telecommunications Theater would give presenters immediate access to *live* images of the animals located on the ET's floor. Having a bug bot located in the snake tank, for example, would allow a presenter in the Telecommunications Theater to show live images of a snake on demand when doing a presentation on snakes. If the ET had multiple bug-bots – each placed in a different animal's tank – a presenter could also provide video of any animal ad hoc, whenever an off-topic question arises. And since bug-bots should not disturb the animals in their tanks, this technology can provide a large audience an in-depth look at an animal in its natural state.

Another useful thing to incorporate with the bug-bots is a simple, one-touch way to record the video stream, either to a videocassette, or a computer disk. This way, if a presenter is giving a presentation and something interesting happens in one of the animal tanks they are watching, they can instantly record the video for later viewing by either the ET staff, or during another presentation. Having these videos stored somewhere means that presenters can show interesting stock footage of an animal during a presentation in case nothing interesting is happening with them.

Multimedia Database

One of the biggest things that staff members at the ET seemed interested in was a way to catalog digital images for easy access during presentations.

Currently, staff members have laserdiscs filled with images that they can incorporate into presentations. The problem with these images is that in order for them to access them, they have to search through an extensive paper catalog to find the image they want. They then have to scan a bar code from the catalog to access the image on the laserdisc and display it on their screen. When giving presentations to children, where off-topic questions often arise, finding an appropriate image can be far too time consuming. Stopping a presentation every time there is a question to search for an image can make for a disjointed and unprofessional presentation.

An idea proposed by ET staff members was to take the images stored on the laserdiscs and place them in a massive computer database. The advantages of this are numerous. First, because the images are on a computer, the index could be computerized as well. Having a keyword-based search allows the presenter to easily find images that fit the topic they are discussing. For example, when a child asks a question about parrots, the presenter could type "parrot" into the computer and the search engine will return all images in the database that show parrots in them.

Another benefit of using a computerized media catalog is the ability to tie audio as well as video and still images into the database. By being able to bring up all forms of media on a particular topic nearly instantaneously, a presenter can make a presentation much more fluid. Questions from students can provide real direction to a presentation, as well as tailor that presentation to the interests of the students involved.

To facilitate the inclusion of multimedia elements from the database into a presentation, search results from the database should ideally provide some sort of preview of the clip about to be used. In the case of photographs this would simply be a thumbnail of the image. In the case of audio or video clips, a short description or a quick preview and perhaps the length of the clip should be displayed. This would allow the presenter to know exactly the nature of any images or sound clips that are returned before they route them for the audience to view. The previewing system insures that the presentation moves along without mistakes or interruptions.

Digital Cameras: Applications of Digital Cameras in the EcoTarium

Digital Cameras for Student Use

A very useful addition to the EcoTarium's technological resources would be several digital cameras. These cameras would aid significantly in the educational applications of the Telecommunications Theater. They provide unique opportunities for staff members to create new and exciting presentations that were previously impossible. Additionally, they introduce additional ways for students to learn that may be very different from anything they have previously done.

One application for digital cameras is based on the idea of an "investigation." An investigation is similar to a scavenger hunt, but with more focus placed on how and why certain elements integrate with a central theme. This program would be best suited for student groups from grades three and up.

An introductory presentation could be given in the Telecommunications Theater to a large group of students, detailing the procedures and the particular focuses of this hunt. This program could be used with a number of the themes currently utilized by the EcoTarium staff in their programs, such as local wildlife, vegetation, or insects. The students could be briefed on the particular focal theme or specific objectives of this investigation and then divided into smaller groups of about four to six students with each group equipped with a digital camera (this number could be adjusted depending on student participants and available cameras). These smaller groups can then walk around the EcoTarium facility and grounds. Once they have found something that they believe meets the criteria or objectives of the search, they could take a picture of it. Later, these smaller groups would meet again in the Telecommunications Theater to present their results.

The images from their digital cameras could be downloaded into the computer in the control area, and they could then be projected, so that each group's pictures could, in turn, be shared with the entire group. The group could discuss whether certain images meet the criteria of the search, and the reasons why or why not. In this manner, the students would be focusing on the environment around them in an entertaining, engaging, and educational fashion.

The transfer of the images could be accomplished a number of ways. One of the options would be to select a camera that saved images directly to disk in a standard image format. These disks could then be collected from the student groups and, using the computer and the data projection capabilities of the

Telecommunications Theater, be projected one at a time. A further advantage of this technique is that the images are retained on the individual disks, so that the students would be able to take them when they leave. This would allow the images to be utilized in the classroom as well, or simply collected by the students. Using digital cameras in conjunction with a docking station or parallel cable would also allow an ET staff member to keep any particularly interesting images they find for use in future programs or exhibits. In this case, the EcoTarium staff would have the primary copy of the investigation pictures. If they wanted to provide the pictures to students as well, then they would have to copy them to disks or burn them onto CDs. Both of the above transfer methods for digital images would yield very similar results.

This use of digital cameras would differ somewhat from programs that the EcoTarium currently uses. For example, some student groups take part in a program called "Animal Detectives." Students learn a wide variety of specific information about several different animals and then go out on the EcoTarium grounds to look for signs of their presence: footprints, chewed pinecones, or trampled undergrowth. They bring some of these signs back and discuss them. However, some of the things they find cannot be brought back. The digital cameras would be very helpful in this situation, allowing pictures to be taken of evidence that cannot be brought back inside. Each group's discoveries could be shared with the entire group, potentially increasing the educational value of the program for the other students.

Digital Images For Use In The Classroom

Students could use the images that they took to compare and contrast with the images taken by other groups when they get back to their classroom. When asked about what types of things students could do with images in their classrooms, ET staff member Catherine Dawson had this to say:

> [Images could be used for] comparison/contrast of ecosystems, habitats, plant life, wildlife continuation or expansion of studies done on-site[.] Once back at school [students could use the images for] continued study of animal markings, camouflage, etc (See Appendix B).

Another way students could use the digital images they took is to come back to the ET at a later date to take more pictures for use as a comparison over time (See Appendix B). That way students could observe changes in the ecosystem from the beginning of their school year to the end, for example. The images could also be incorporated into student projects such as written reports, or multimedia presentations (See Appendix B).

Digital Cameras for Family Use

Besides student groups that come to the ET on field trips, it also has another source of patrons – families with small children. Since the ET will already have the technology in place to utilize the digital cameras with student groups, it only seems logical to allow families to use them as well. The ET could provide several digital cameras that families who visit could borrow or rent.

One interesting aspect of allowing families access to digital cameras is that giving them the opportunity to take pictures can make them more aware of their surroundings. Because they are searching for things worthy of a

photograph, they become more active observers. There are a lot of things on the ET grounds that are worth seeing, but are often too subtle to notice without careful attention. When families are looking for things to photograph with the digital camera, they will be more likely to notice these subtle details. It will also give them the opportunity to record things that are perhaps unusual or happen very infrequently: for example, a bird egg hatching, or an animal constructing a home. These are things that are rare and could make for some unique photographs.

Families would also enjoy keeping some of the pictures of the things they see. With so many interesting plants and animals on the ET grounds, such as the snowy owls or the eagles, the ET could provide services for people to print the digital pictures out as posters or photographs. They could also offer to transfer pictures to a floppy disc or CD so that the family could take them home and view them on their personal computer. This would help families remember their visit as well as provide them with some potentially beautiful or unique photographs. Often times people do not think of taking a camera to a place like the ET because it's so close to their home and they do not think there's anything unusual to see. Forcing them to take notice of these things could also help them notice the beauty in their own back yards.

The ET staff could also help aid people in their search for things to photograph by providing signs posted near things that are worth photographing. For example, signs posted near rare or interesting plants or near vacated animal dwellings would alert visitors to things they may want to take pictures of.

Additionally, the ET staff could help families identify the things they photograph once they return. Often it is difficult to identify things seen in nature. Having an expert on hand to explain them to you can make the experience much more educational and rewarding. It also frees staff from having to walk the nature trails with each group – something that would be outrageously time consuming – while still giving them a sort of personal attention while they search the grounds.

This interaction between family groups and staff members could also benefit the ET. One thing that staff members have pointed out is that often the ET staff has trouble taking tours of their grounds in search of interesting things they can show to students. If families and independent groups had digital cameras and gave the staff access to their recorded images, a staff member could then sift through the pictures and locate any images of things that was previously unknown to the ET staff. The staff member could then take those pictures and add them to their own collection of images, and make use of those images for display to students during school presentations in the Telecommunications Theater.

Certain images could also prove useful to the staff for doing research. If someone photographed a new or rare animal or plant, it could clue staff members into the presence of something that they previously were not aware of. The fact that staff members could get this knowledge without having to actually search the grounds makes it more likely that the staff will find any and all interesting things found there.

Digital Cameras for Staff Use

The use of digital cameras at the EcoTarium is not limited to student groups or families. There are many ways that the ET staff can use digital cameras. From getting picture samples of the local environment, to the freedom that the capability to further customize presentations brings, to the ability to capture rare occurrences digitally as they happen, the digital camera is a valuable resource for the ET.

The ET's goal is to promote environmental science education with an emphasis on Worcester and neighboring towns. Through the use of exhibits geared toward the local environment, the ET provides a place for students and families to come in and look at their environment in a different way. The staff also takes groups outside the ET along the many nature trails that run along its grounds. This provides the opportunity for the staff to point out things that group members may take for granted but is unique to the New England environment. If the staff had pictures of the items that they are going to point out to the group beforehand, the group members themselves could be on the lookout for the various subjects. A digital camera would be ideal for that purpose. They are also helpful when the staff gives presentations to groups in the Telecommunications Theater. Currently, the staff at the ET uses laserdiscs and bar codes to access the images they deem pertinent to a particular presentation. When a staff member wishes to view a picture that is on a particular laserdisc, he or she must scan the bar code for the picture they wish to view, and it comes up on the screen. These pictures and bar codes are catalogued in a book.

The drawback of the laserdisc method is that not all of the laserdiscs have images from the Worcester area. In some cases, the images from the laserdiscs are comparable to images that could be taken in and around the general vicinity of the ET. Many times, however, the pictures on the laserdiscs do not accurately portray the natural environment of the Worcester area. The advantage of having a digital camera is that a staff member can go out into the woods to photograph a certain animal, or to take panoramic shots of the area, and bring the results back to the Telecommunications Theater for viewing and/or discussion.

Instead of having to scan bar codes in order to display images, all a staff member would have to do is perform a search for whichever picture is needed at a particular time (see the previous *Multimedia Database* section). This could conceivably save time for the staff member, as he or she does not have to flip through a book filled with bar codes to find a particular image. The images could also be put onto a CD for later use. That way, images of a particular type can all be in one place. In order to retrieve the images taken, a staff member would put the CD into the drive, and bring up the desired images. This method is also faster than searching for and scanning bar codes, as long as the CDs are easily accessible, and the staff member has access to a CD-ROM. In fact, entire presentations can be put onto CDs (i.e. PowerPoint presentations), which can also be very helpful to staff people. This is beneficial to both the ET staff and to the groups that visit, because it gives the staff the ability to pick and choose the photos that are incorporated into any given program, and it gives the groups the advantage of seeing something that could very well be in their own back yard.

This aids the ET in educating the groups about the local environment, because they can identify more with the images they are shown. This opens up new avenues for the ET staff to pursue.

Armed with a digital camera, a staff member has the power to completely customize his or her presentation. For example, if a staff member is giving a presentation on nesting habits of local birds, it is advantageous to take pictures of the birds and their nests, and perhaps prepare a slide show for the group coming in. These digital photos can also be supplemented by images and/or sounds from a laserdisc, if the laserdisc has the appropriate material on it. The addition of the digital camera greatly allows the staff member to tailor the presentation to the needs of the group that he or she is presenting to.

Another reason that a digital camera would be important for ET staff to have is the spontaneity factor. For example, imagine a staff member is leading a group around outside the ET, exploring the wetland area and its inhabitants. As the group is walking to the pond, one of the members points out something out of the ordinary. Upon inspection, it seems that this is an occurrence that does not happen every day. With a digital camera, the staff member can easily take a photograph as the event is happening, without disturbing the environment at all. After the tour is over, the group can go back to the Telecommunications Theater, bring the image up onto the screen, and discuss the findings. Without the benefit of a digital camera, the staff member would have to wait until the film from a regular camera was developed, and by that time, the moment is past, and the original group cannot go into as much detail as it could have if they had the

image on a large screen. In this case, the use of a digital camera can give rise to discussions that were not planned by the staff, but are still very useful in educating the group about the local environment.

Digital Cameras: Specifications

Capabilities

The first factor to look at when choosing an acceptable digital camera for a particular use is its resolution, or the number of pixels it uses to store an image. Poor quality cameras use less than one megapixel (1,000,000 pixels) per image. These cameras are generally of too poor quality for anything but the most cost-efficient uses. High quality cameras employ more than three megapixels per image and provide impeccable image quality. These cameras, however, also sell for prices of the order of $10,000, and are far too expensive for use in this instance. Medium quality cameras fall somewhere in between, using between about one and three megapixels. These cameras are generally reasonably priced, and produce images that are acceptable for display in the Telecommunications Theater. Other factors that affect the image quality of a picture in the digital camera are image reproduction issues such as sharpness, contrast and color reproduction. These are factors that improve, as one might expect, as camera quality (and consequently price) increase.

As with any piece of electronic equipment, ease of use is also an issue. Because these cameras are to be used with children, they must be simple to operate. Many cameras add complex features for enhancing the appearance of an image. While these features are of interest to professional photographers,

they are actually detrimental when working with children in an informal setting as at the ET. Any camera that the ET should consider should be able to be simplified to a "point and click" interface. All complicated menus and other elements aside from the snap button should not be required for a person to take a simple snapshot. A feature that makes a camera simpler to use is having a LCD screen instead of an optical viewfinder. This allows someone to preview the image being captured and also provides an interface for all menu elements.

A digital camera without an interface to a computer is a useless tool. Because of this, the interface from the camera to the computer and the software the camera comes with are *very* important features when looking for a digital camera. Many old cameras (made more than one year ago) come with a serial link only, meaning that they can only interface with Windows PCs, and only at a fairly slow speed. Newer cameras come with a USB (Universal Serial Bus) connection, either as its only connection form, or in tandem with a serial connection. This allows for the possibility of the camera being cross-platform (i.e. it can work on both PCs and Macintosh computers), and also lets the camera transfer its images an order of magnitude faster than serial cameras. Another transfer method, which is quickly being replaced, is floppy disks. This has the advantage that it's easy to understand and set up. There is no software to install, or cables to connect. Along this line is the digital media card. These cards are similar to floppy disks except that they are much smaller and much faster, but are also much more expensive.

Another key feature to consider in a digital camera is the number of pictures it can store without uploading the images to a computer. Many cameras that use floppy storage only store about 20 images. Other cameras have four or eight MB of storage cards and can store about 40 and 80 pictures respectively. Cameras with this type of media are preferred for this scenario because 20 images may often be too few for an entire outing. Also crucial is the typical battery life. Many cameras can only capture 100 or so images on a single battery replacement. This is probably not enough for the ET's work, and they would probably need a camera with 500 or more images per battery, to avoid the nuisance of having to replace batteries while out on an investigation with students.

Cameras

With so many choices in digital cameras these days, it can be difficult to find one that meets the ET's specific needs. In an attempt to weed out the less than optimal cameras, we turned to Computers.com (http://www.computers.com/). Computers.com is a web site devoted to the review of computers and computer hardware. It is maintained by the extensive expertise of CNet, a company devoted to providing service, support and purchasing tips to the millions of people who use computers and need accurate information about them. The site contains a category for digital camera reviews and provides a wealth of information regarding the pros and cons of every camera in every price range (See Appendix C). It recommends several inexpensive cameras that still

provide respectable image quality and also have other features that may prove useful to the ET.

The first camera recommended by Cnet is the HP PhotoSmart C200. Typically priced for under $300, it provides a resolution up to 1,152 by 872 (just less than one megapixel). Cnet's review also mentioned that it contained other features that may prove useful for the ET's uses. It has an LCD screen and has a zoom feature that will be useful for photographing animals without disturbing them. It contains eight MB of storage so image capacity should not be a problem for the ET, but it is only compatible with PCs through a serial link. It also has the added benefit of being able to display its images directly on a television without having to go through a computer at all. This would make it extremely useful for displaying student images in the Telecommunications Theater, bypassing the slightly time consuming task of importing the images into a computer. It has only the most basic functions of a camera, and has a very simple interface, without many other elements to bog the user down – a very good camera for young students.

Another camera recommended by Cnet is the Olympus D-340R. It, like the C200, retails for around $300, but provides a higher resolution and much better image quality. With a 1200x960 resolution (more than one megapixel), the image quality on the D-340R should be more than sufficient for the ET's uses. Similar to the HP, it can output directly to a television, but unlike the HP, it can be used with both PCs and Macintosh computers. Its interface is slightly more confusing than need be, but it should still be fine for student use. It has 4 MB of internal memory,

but has the additional feature of being able to support 32 MB of removable media and can accommodate up to 120 photographs. It has respectable battery life, but unfortunately has no optical zoom. Although it does have a decent digital zoom, this is no substitute for a true optical zoom. This limit alone may be enough to limit this camera's usefulness for photographing animals on the ET's grounds.

Chapter 5: Follow-up Projects

In order to examine fully the possibilities of the Telecommunications Theater, we recommend that some follow-up projects be considered. These projects come as a result of conversations with ET staff, in which they stressed certain needs. We tried to address these needs as thoroughly as possible throughout our project, but due to time constraints, and the magnitude of attention these projects require, it would be useful to have separate projects continue where we left off.

The first project would be the creation of the searchable multimedia database we discussed previously. As stated before, the database must be quickly accessible and easily usable by ET staff, or it would not be effective. This would be beneficial to the ET because all of the sounds and pictures collected would be in one spot, with only a keyword search standing between staff and media, and the touch of a button to bring it to an audience.

Another project would be a continuation of our own project, as either an expansion on our ideas, or as a separate project with a focus on ET programs and how they should be adapted for optimal use in the Telecommunications Theater. For this project, a group could work closely with the new staff person the ET is hiring. This person (the technology integration specialist) is "responsible for the innovative integration of computer technologies into school group programs, school partnerships and museum programs."[11] Together, the technology integration specialist and the IQP group could cover more ground than either the staff member or the IQP group alone.

An advantage to having this type of project is the fact that its scope and purpose will already be well defined. This project would allow for a great deal of creativity on the part of the students as well. Fully utilizing a room such as the Telecommunications Theater is not a simple task, but it is a highly rewarding one. This project would fit perfectly into WPI's idea of an IQP – it is, at its core, a project integrating technology in the Telecommunications Theater with and the educational mission of the ET. This project should also be of great interest to the EcoTarium, as they would be getting new ideas for presentations and programs from a source they would otherwise not have access to.

Chapter 6: Conclusion

The origin of our IQP began many months ago with a meeting with Dr. Dolores Root, the Director of Exhibits at the ET. During this meeting, Dr. Root described to us three very interesting proposals for the overall theme of our project. Of the three, the one that struck us as the most interesting was a project concerning the utilization of the ET's new and then yet-to-be-constructed Telecommunications Theater. This project intrigued us, particularly because the connection between the technology in the Telecommunications Theater and the educational mission of the ET represents the very nature of the Interdisciplinary Qualifying Project as WPI defines it. From this initial conversation with Dr. Root, out minds were set in motion to think of the most effective and innovative ideas for using the Telecommunications Theater.

The first major idea that came to our minds when thinking about what could be done with a "telecommunications theater" was to use it for distance learning. This seemed to be a logical focus our project, due both to the technology included in the design of the Telecommunications Theater, and to the ET's focus on promoting environmental education. We thought that distance learning might be able to extend the ET's influence to those outside of the Worcester area and thus help to attract more visitors to the ET, as well as to help educate people outside the area about the New England environment. Unfortunately, we got caught up in the vastness of the subject of distance learning. It proved to be an extremely broad area, and one that did not seem to be completely understood or fully developed. In spite of this, we did come across

several valid approaches to distance learning; however, there were not many that fit in with either the technology in the Telecommunications Theater or the mission of the EcoTarium.

Additionally, we were warned several times by Dr. Root about a common practice of distance learning she calls "Talking Heads" – an approach to distance learning wherein a presenter simply lectures to a remote audience from in front of a camera. Virtually all of the common approaches we saw fell into this category, and it quickly became apparent to us that we could not focus our project on distance learning. Our focal point instead shifted to maximizing the output of the Telecommunications Theater and to aiding the ET staff in the transition to using the Theater. From many conversations with various staff members, this was then refined until we arrived at our current focus: utilizing the Telecommunications Theater in such a way as to provide visitors with a more multi-sensory experience.

To achieve this goal, we expanded on and refined some of the suggestions made by ET staff during our conversations. These conversations were crucial to the success of our project. The need for the ET to have fast, random access to such media as pictures and audio gave rise to the idea for the creation of a multimedia database that uses a keyword-based search. This is advantageous because when off-topic questions arise during a presentation (as they often do), a staff member can easily switch gears and answer them without having to stop the entire presentation or wait for a better opportunity to speak

about the subject. This makes presentations more flexible; many topics can be discussed during any particular session.

Another useful idea that came out of our conversations with ET staff was that of bug-bots. This is beneficial for both the ET staff as well as the animals involved. The staff benefits by the ability to have more than just a few people view a particular animal at one time, as well as the advantage that magnification of specimens brings when they are projected on a large screen. The animals benefit by not having a group of people crowding around them, poking at their enclosures and making them nervous.

We also formulated our own idea of how the Telecommunications Theater could best be used. We felt that the best application of the available technology was for the ET to invest in digital cameras. This approach has advantages for both staff and ET patrons as well. The staff benefit by the ability to further customize and tailor their presentations to suit the needs of the group they are presenting to. Student and family groups also benefit from using digital cameras. For families, it is the ability to bring the pictures they took home with them to keep. For students, bringing digital images back to the classroom provides the benefit of continued discussion and learning outside of the ET.

All of the ideas we've listed serve to better utilize the advanced capabilities of the Telecommunications Theater, and to provide ET patrons with a more memorable experience that caters to all of their five senses. We believe that with the technology now available to the ET, many more programs will be created in order to take full advantage of the educational benefits it offers.

Chapter 7: Afterword – What we would do differently

In the process of doing any large project there are invariably mistakes made and incorrect paths taken. It is impossible to predict the final direction of a project the size of an IQP when it is first begun. In doing our IQP, there were several paths we went down that proved unfruitful when our final ideas were considered.

The first thing we investigated that ended up being a dead end was our exploration into distance learning. A lot of time was spent early in the project investigating the relationship between technology and distance learning. We originally considered the Telecommunications Theater as a way for the EcoTarium to bring itself into this sphere. There was a lot of research into the exact nature of distance learning and into the ways it has been utilized successfully. It proved to be too undeveloped an idea and seemed to provide very few real benefits over traditional, hands-on education. Consequently, we abandoned it as the focus of our IQP, although we did so far too late. If we had it to do again we would choose to ignore distance learning all together and instead focus our efforts in other, more fruitful directions.

Another thing that we would have liked to see happen was for us to have more communication with the ET staff during the research phase of our project. Over the course of this phase, we came up with a lot of questions that the ET staff was more than capable of answering for us, but due to scheduling conflicts we were unable to meet as much as we would have liked. Early on in the project, ET staff members were easy to get in touch with and always willing to speak to

us when we had questions. This presented a problem in that we did not have a substantial number of questions for them at the time, as we were still in our distance learning phase of research. As our focus changed, so did the availability of the staff. In the final weeks of our project, we had a number of issues we needed clarification on. However, due to time constraints brought on by the Spring Rush at the ET, the staff members that we most needed input from were the ones that were the least available to us.

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[7] Danilov.

[8] http://www.ecotarium.org/info/general/index.html

[9] "Earth Matters."

[10] http://www.jasonproject.org/whatis/whatis_main.html

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Appendices

Appendix A: Interview Summaries

Appendix A contains brief summaries of interviews we had with four EcoTarium staff members over the course of our project: Catherine Dawson, whom we interviewed on January 28, 2000; Mike Nelson, whom we interviewed on February 17, 2000; Doug Potter on February 24, 2000; and Dr. Delores Root on May 5, 2000. These interviews, while not the only interviews we conducted, were by far the most integral to the goals of our project.

Catherine Dawson Interview Summary - 1/28/00

Catherine Dawson, who at the time we interviewed her was the Manager of School Partnerships & Professional Development, has since left the ET. We interviewed her in January to get her impressions of our project and to get any suggestions she might have for routes we may like to investigate.

We began the interview by explaining our view of the project to Catherine and in what direction we wanted to go. She seemed to like the scope of the project as we had defined it. We asked her if she would be presenting and she said that she does not do exhibits but that she would present when the EcoTarium does teacher workshops. She then went on to explain that the first use of the room, for her at least, is for teacher workshops, not for student presentations. She went on to talk about the collaborative groups that visit the ET, although she did not go into too much detail about them – only that they visit one or two times a week. Our impression was that the collaborative groups were not going to be using the Telecommunications Theater much anyway.

We asked her about the format of student visits to the EcoTarium. Catherine said that presentations in the Telecommunications Theater only last for 45 minutes maximum and that most student groups are only in the ET for 3-4 hours a day at the most. We discussed our idea of having students separate into groups to do research and then come back together to present their findings in the Telecommunications Theater. Catherine seemed very interested in this idea, especially for the High School students. She also said that they planned on doing the same thing in the teacher workshops.

She definitely seemed to think that the EcoTarium would be more of a receiver of distance learning technology than a provider of it. The only things Catherine thought the EcoTarium might provide would be in the form of web posts and online forums where students could post the results of activities and share data, etc. Another use for online technologies Catherine thought of was for students to get information before coming to the ET and for getting follow-up information after their visit. She also mentioned that the Telecommunications Theater could be used for viewing information downloaded from satellites, and that the EcoTarium could show programs that WGBH puts on, but aside from that, she does not think they have the capability to handle true bi-directional distance learning.

Catherine seemed concerned that students do not come to the EcoTarium enough. She wants more students to return for follow-up visits and she seemed very interested in getting high school students into the ET. She also mentioned

the virtual high school program in New Hampshire, citing that the program is wildly successful and that everyone wants to get involved.

Catherine mentioned that she sees the Telecommunications Theater as simply a tool to enhance education. She said that the room, in her mind, is education driven, not technology driven. She sees the technology as a way to combat the MTV generation effect; that is that bigger, brighter and flashier is better. We asked Catherine what the focus of the EcoTarium was. She said that they focus on the area of environmental education, and particularly how it pertains to Worcester and the surrounding area. She made the distinction between environmental education and environmental science, saying that the EcoTarium did not want to cover environmental science.

Presently, the EcoTarium is doing presentations on a roving cart. Prior to the use of the cart they did presentations in a stadium-seated auditorium, which has since been removed. The room was not up to their high standards, so they got rid of it. For a while they did presentations for the JASON project on a *huge* computer that has been outdated since 1972.

It became apparent that because the Telecommunications Theater was developed so quickly, the staff at the ET had insufficient time to come up a plan of attack for using the room effectively. It also seemed that online exhibits were nowhere on the EcoTarium's agenda, or at least not at this time.

We left with Catherine to look for ET contacts. Along the way we found Jesse Anderson who introduced us to Mike Nelson and Douglas Potter, whom

we are going to contact in the near future. We also agreed to meet back with Catherine within one month's time.

Mike Nelson Interview Summary - 2/17/00

- Currently, technology is most useful for showing things to large groups at the same time.
  - Flex-cam object camera
  - Video microscope
- Use of multimedia (images, audio and video clips)
  - Currently use CDs and Laserdiscs of bar-coded and cataloged multimedia
  - Access is not immediate. Planned images can be accessed as needed, but it is difficult to adapt presentations and programs to meet audience questions on the spot.
  - Interested in the ability to project audio of live animals to the auditorium.
  - Also considered the use of remote controlled "bug-bots" for projecting images of animals in the tanks
- Target groups
  - School groups
    - Usually small, single class size
    - Spring Rush, generally several classes combined
    - General target audience range is grades K-8
    - Some high school programs on specific days
- Considerations for Telecommunications Theater
  - He has not put much thought into adapting his programs to the Telecommunications Theater
  - He recognizes the Telecommunications Theater as a very useful tool and is very receptive to ideas for its use
  - EcoTarium is currently searching for a person to integrate the Telecommunications Theater into their programs on a full-time basis

Doug Potter Interview Summary - 2/24/00

Currently a lot of presentations use VCR's, laserdiscs, and video microscopes. Doug simply sees the Telecommunications Theater as more centralized location for these items. He hopes this centralized location makes presentations more interesting, because the lack of having one central location makes it difficult to present coherent presentations. Under the current setup, students and other listeners have no control over the flow of the presentations now. He would like to give them more control over the direction of the presentations to create a much more interactive experience.

A big thing he wants is flexibility in the technology in the Telecommunications Theater. He wants to bring technology out onto the floor and into the classroom to do presentations. He likes what he called "Smart Carts." Smart Carts are basically mobile carts that provide services like VCR playback or a video microscope so that presentations can be done in places like the Microdiner or some other exhibit. He felt that this would allow exhibits to be more interactive and would give the students a chance for more one-on-one learning. He would also like some unique technology to put on the carts, different from the standard VCR and video microscope.

Doug's ideal setup for doing a presentation would be to have central "server" that would be able to control all possible screens and all possible video and audio sources. It seems from what we know about the Telecommunications Theater that this is the way the room will work. He also mentioned that he wants

to use the Internet better, but that he had not put enough thought into it to know exactly how or to what end.

Dr. Dolores Root Interview Summary - 5/4/00

Our interview with Dr. Root came at the end of our project after all of our investigative work had been done. We met to show her our progress on the project she had proposed to us six months prior – a project that she had had very few updates on since that original meeting. We began our interview by telling Dr. Root about our primary idea – to have students take digital cameras with them on "scavenger hunts" in order to take pictures of things they find. Staff members could then plug them into the A/V system of the Telecommunications Theater and show all the students pictures to the entire group. We pointed out that it would be more useful if the ET took existing programs and adopted them for use with digital cameras, an idea Dr. Root seemed to love. She pointed out that previously, museums used to do similar things with Polaroid cameras and throwaway cameras.

A big concern we had was the question of whether the ET would be able to get funding to buy digital cameras or not. Dr. Root pointed out that because the cameras would simply be tools in this instance, camera quality and pixel count is not extremely important. This means that the ET could get cameras for a couple hundred dollars and therefore funding should not be a problem.

Catherine Dawson had given us several ideas for how students could use the cameras both inside the ET and at school. Her ideas to take pictures at ET and take pictures at school and compare the differences or to take the same picture at different times of the year or over multiple years seemed like a good idea to us, but we wanted to get Dr. Root's impressions of them. She said that

observing seasonal change (or year-to-year change) of a single spot is an important thing in environmental education and therefore digital cameras fit in nicely. She seemed to think that using digital cameras as tool to point out easy-to-ignore things that happen all around us is a very good idea. She even pointed out the idea of students possibly putting images on the web for kids to look at from one school year to the next – an online scrapbook of sorts.

The history of the Telecommunications Theater and how the ET got funding for it was a question we also wanted to get an answer to. According to Dr. Root, the origins of the Telecommunications Theater were rooted in the ET's participation in the JASON project. To take part in the JASON project, an institution needed a substantial level of technology and therefore a great deal of funding. The ET got sizable grants from NOAA (the National Oceanic & Atmospheric Administration) for purchasing the satellite dish and other equipment needed to be included in the JASON project. The ET had bleachers and a room set up for the JASON project, all of which was purchased with grant money.

The work they did with JASON forced them to realize that they needed a much larger space for doing presentations. At the time of the JASON project, presentations at the ET that needed to be done in front of a large group were done in the Planetarium, a space that can only hold roughly 100 people and which is not really designed for this purpose. This caused the ET to start working intensively with architects and A/V contractors to build the Telecommunications Theater. Dr. Root said that when it came to designing the contents and

capabilities of the room, everyone at the ET had input. She also mentioned that because the space had other uses (such as for corporate rental for large presentations, etc.) the room had to be flexible.

The work the ET did with JASON also led them to think of doing distance learning with the new equipment they had. Dr. Root pointed out that even after all this time, distance learning seemed to be nothing more than talking heads to her. She mentioned that even though the ET wanted to do distance learning on other levels, it still does not work because, in general, a sufficient number of schools are not connected. We agreed with her feelings about distance learning and told her about our experiences. We told her about the New Hampshire Virtual High School and how it was basically just a web bulletin board. We told her about our trip through distance learning and about our search for information concerning it on the Web. We explained to Dr. Root how we scrapped distance learning and instead decided to look for ways the ET could use the Telecommunications Theater for programs and presentations in house.

Dr. Root also noted that it was her opinion that her staff might think the new facility would basically be used to do an updated version of the JASON project, but that in reality it would be better used to bring current presentations to life. She said we had a "neat idea" to use a digital camera as a tool to make learning more interesting. We mentioned some of Mike Nelson's ideas as to programs that could be adapted for use with digital cameras, leading Dr. Root to tell us about their new butterfly garden on the front lawn. She pointed out how some students might miss certain butterflies when they are outside, but if kids

could take pictures of them, everyone can see everything. Professor Jasperson asked if our idea seemed practical and if there were any potential pitfalls. Dr. Root seemed very enthusiastic and said it was a "very practical" idea. The use of digital cameras, in her opinion, would have a lot of appeal to a younger generation of kids who are interested in technology.

Appendix B: Email Correspondence

Appendix B contains email we received from EcoTarium staff in response to various questions we posed to them. These do not represent the full breadth of emails we received from staff members at the ET, but rather only those emails that provided us with critical or original information.

Mike Nelson email - 4/11/2000

On Sun, 9 Apr 2000, Joshua Grossman wrote:

> Mike, here's an intro to the paper we're going to write for our IQP. It
> basically describes our ideas for uses of a digital camera at the EcoTarium.
> We were wondering if you could read through it and let us know what you
> think of our ideas. In particular we have these questions:
>
> 1) How would you implement our suggestions for digital camera use in your
> presentations to students?
>
> 2) If you were to adapt current student presentations to the digital camera
> idea, what changes would be made?
>
> 3) How would this approach differ from your current approaches for
student presentations?

The use of digital cameras could be incorporated into the current program

"Animal Detectives" just as you described - by allowing the group to

gather together in the telecom theater and share what they have found using images.

Another popular program for school groups is "Life in the Pond," in which

we go out to the pond to collect plankton, which we bring back to the theater to view under a video microscope. One problem with this is that the tiny crustaceans we are viewing constantly swim out of the field of view. It would be great if we could "freeze frame," or capture an image from the video microscope. I don't know if that would involve a digital camera or just some other device/capability added to our current video microscope setup.

The new program "Exploring the Tree" is similar to "Life in the Pond," in

that we don't have problems bringing what we find back to the theater (in this case insects), but viewing with the FlexCam can be tricky and being able to capture images would really help. This would also apply to our other programs on Arthropods in which we view insects and such with the FlexCam.

A program that might really benefit from using digital cameras is "Knights

& Nature." This is a cooperative program with Higgins Armory; student go

to the Armory to learn about medieval armor, etc., and then come to the EcoTarium for a program on animal defenses such as protective body

coverings, camoflage, etc. This program usually involves a "scavenger hunt" component in which students must find examples of things discussed in the program by looking through the museum and at our live animals. So digital cameras could be used to bring back images of the things found for discussion.

> 4) Are our ideas for staff use of the digital cameras applicable as we have
> them (i.e. are they reasonable)? If they're not useful, do you have any
> suggestions to improve them, or if they are, how come?
>
> 5) Can you think of any other functions of the staff that a digital camera
> might be useful for?

What you've described for staff use of digital cameras sounds reasonable

and very useful. One concern I have is that taking pictures of wildlife as you have described often requires the use of a telephoto lens. The only digital cameras I have seen or used are the standard "family cameras," which often have a zoom lens, but nothing close to the power of even a low-power telephoto lens. Are telephoto lenses for digital cameras available?

One other comment - I am concerned about just "handing out" digital

cameras for students and the general public to use. I think use would have to be supervised to prevent damage to or loss of the cameras. So digital cameras might not save quite as much staff time as you have suggested in youre paper. But otherwise they're a great idea. And if the ability to capture images can be extended to microphotography (plankton, etc.) and distance photography (wildlife), the technology would be even more useful.

I hope my comments help. Let me know if you have more questions.

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Catherine Dawson email - 4/19/2000

Sorry about that. I am only here part time and my last day is next

Wednesday, so my schedule is rather hectic.

I think the idea is a neat one. A suggestion on language -- in the museum

world a scavenger hunt implies hunt and find, with a lack of conceptual depth. To really support the use of the cameras, you would need to argue for their use in an "investigation" or project. I would talk a little more about the benefits of capturing an image rather than an artifact that they simply observe in-situ or being back into the classroom. Also, the images could be used for comparison and contrast between groups and over
time to show how it changes. We are trying to strengthen work done pre and post visit, and the kids could take it back to school to collow up and do comparisons with what they find on the school site.

You also need to at least acknowledge some of the challenges -- expense of

purchase, maintenance; learning curve on use of cameras, etc.

If you still were interested in coming in to talk at a program staff

meeting, you will need to set that up directly with Dolores at this point: droot@ecotarium.org since I won't be here. Best of luck with the rest of the project!

Catherine

On Wed, 19 Apr 2000, Joshua Grossman wrote:

> We were wondering if you've had a chance to read our paper? Do you have any

> comments or suggestions? We'd appreciate a response as soon as possible,
> because our final paper is due in less than two weeks.
>
> Thanks, for you time
>
> Joshua Grossman
> Jason Dougherty
> Eric Kenney

Catherine Dawson email - 4/24/2000

> Our first question is in regard to kids taking pictures back with them from
> the EcoTarium to their school. You mentioned that it might be nice for them
> to do comparisons of what they find at their school with what they found at
> the ET. Could you elaborate on this idea at all? What kinds of things do you
> see students doing at school with these photos in hand?

comparison/contrast of ecosystems, habitats, plant life, wildlife
continuation or expansion of studies done on-site once back at school
continued study of animal markings, camouflage, etc.
(just to name a few!)

> Can you think of any other ways that students might be able to use images
> they take at the EcoTarium and do work with them back in their classrooms?

Visual record to be incorporated into written documents (reports, essays, stories, articles), multimedia presentations, artwork, etc.

> I know these are sort of broad questions, and that you're short on time, but
> any information you can give us is greatly appreciated.

Sorry to be so brief, but I am swamped!

Catherine

Appendix C: Digital Camera Price List

Camera Information	Est. Price
Olympus D-340R PC, Mac, 1280 x 960 max. resolution, serial, NTSC video out interface, autofocus lens	$298
Olympus D-360L PC, Mac, 1280 x 960 max. resolution, NTSC video out interface, autofocus lens	$399
Kodak DC210 Plus Zoom PC, Mac, 1152 x 864 max. resolution, serial, PC Card, IrDA, NTSC/PAL interface, autofocus lens	$429
Agfa ePhoto CL30 PC, 1152 x 864 max. resolution, serial, USB, NTSC video out interface, autofocus, manual focus lens	$350
Canon PowerShot A50 PC, Mac, 1280 x 960 max. resolution, serial, NTSC video out interface, autofocus lens	$499
Epson PhotoPC 650 PC, Mac, 1152 x 864 max. resolution, NTSC video out interface, autofocus lens	$349
Fuji DX-10 PC, Mac, 1024 x 768 max. resolution, serial interface, manual focus lens	$299
Fuji MX-500 PC, Mac, 1280 x 1024 max. resolution, serial, TV interface, autofocus lens	$374
HP PhotoSmart C200 PC, 1152 x 872 max. resolution, serial, NTSC interface, autofocus lens	$299
Kodak DC215 Zoom Millennium 2000 Edition PC, Mac, 1152 x 864 max. resolution, USB, serial, PC Card, NTSC video out interface, fixed focus lens	$399
Kodak DC240 Zoom Digital Camera PC, Mac, 1280 x 960 max. resolution, serial, PC Card, USB interface, autofocus lens	$463
Minolta Dimage V PC, Mac, 640 x 480 max. resolution, serial, PC Card interface, fixed focus lens	$350
Mustek VDC-300 PC, 640 x 480 max. resolution, serial, USB, NTSC video out interface, autofocus lens	$205
Olympus D-450 Zoom PC, Mac, 1280 x 960 max. resolution, serial, NTSC video out interface, autofocus, manual focus lens	$500
Panasonic PV-DC2090 PC, Mac, 1280 x 960 max. resolution, serial, NTSC video out interface, autofocus lens	$499
Polaroid PDC-700 PC, 1024 x 768 max. resolution, serial, NTSC video out interface, autofocus lens	$247
Polaroid PhotoMax PDC-640 PC, 640 x 480 max. resolution, serial interface, autofocus lens	$205
Toshiba PDR-M4 PC, Mac, 1600 x 1200 max. resolution, serial, USB interface, autofocus lens	$438
Umax AstraCam PC, 1280 x 960 max. resolution, USB interface, fixed focus lens	$199
Agfa ePhoto 1280 PC, Mac, 1280 x 960 max. resolution, serial interface, autofocus, manual focus lens	$347
Epson PhotoPC 700 PC, Mac, 1280 x 960 max. resolution, serial interface, autofocus lens	$482

Konica Q-M100 V $389
PC, Mac, 1152 x 872 max. resolution, serial interface, autofocus lens

Nikon Coolpix 900s $463
PC, Mac, 1280 x 960 max. resolution, serial, PC Card interface, autofocus lens

Olympus D-340L $426
PC, Mac, 1280 x 960 max. resolution, serial interface, autofocus lens

Ricoh RDC-4300 $449
PC, 1280 x 960 max. resolution, serial interface, autofocus lens

Toshiba PDR-M1 $412
PC, Mac, 1280 x 1024 max. resolution, serial interface, autofocus lens

Agfa ePhoto 780 $261
PC, Mac, 1024 x 768 max. resolution, serial interface, fixed focus lens

Agfa ePhoto Smile $102
PC, 640 x 480 max. resolution, serial, NTSC interface, autofocus lens

Casio JK-710DC Digital Camera Card $284
PC, Mac, 640 x 480 max. resolution, PC Card interface, autofocus lens

Casio QV-300 $434
PC, Mac, 640 x 480 max. resolution, serial interface, autofocus, manual focus lens

Casio QV-5000SX $497
PC, Mac, 1280 x 960 max. resolution, serial interface, autofocus lens

Casio QV-700 $370
PC, Mac, 640 x 480 max. resolution, TV interface, fixed focus lens

Casio QV-770 $362
PC, Mac, 640 x 480 max. resolution, serial interface, autofocus lens

Casio QV-780 $343
PC, Mac, 640 x 480 max. resolution, NTSC video out interface, autofocus lens

Epson PhotoPC 650 $399
PC, Mac, 640 x 480 max. resolution, NTSC video out interface, autofocus lens

Fuji FinePix 1400 Zoom $399
PC, Mac, 1280 x 960 max. resolution, USB interface, autofocus lens

Fuji MX-1200 $274
PC, Mac, 1280 x 960 max. resolution, serial interface, autofocus lens

Kodak DC200 $399
PC, 864 x 1152 max. resolution, PC Card, serial interface, autofocus lens

Kodak DC200 Plus $399
PC, 864 x 1152 max. resolution, PC Card, serial interface, autofocus lens

Kodak DC215 Zoom $319
PC, Mac, 1152 x 864 max. resolution, serial, PC Card, NTSC video out interface, fixed focus lens

Kodak DC50 Zoom $459
PC, Mac, 756 x 504 max. resolution, serial interface, autofocus lens

Mustek GSmart 350 $190
PC, Mac, 640 x 480 max. resolution, USB interface, fixed focus lens

Mustek MDC-800 $261
PC, 1012 x 768 max. resolution, USB, PC Card, serial interface, autofocus lens

Mustek VDC-200 $150
PC, 640 x 480 max. resolution, serial interface, fixed focus lens

Mustek VDC-3500 $120
PC, 640 x 480 max. resolution, PC Card, serial interface, autofocus lens

Nikon Coolpix 900 $344
PC, Mac, 1280 x 960 max. resolution, serial, parallel, PC Card, TV interface, autofocus lens

Olympus D-460 Zoom $499
PC, Mac, 1280 x 960 max. resolution, serial interface, autofocus, manual focus lens

Umax Astra 1000 $150
PC, 640 x 480 max. resolution, USB interface, fixed focus lens

Vivitar ViviCam 2700 $319
PC, 640 x 480 max. resolution, serial, TV interface, fixed focus lens