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A Case Study of the Use of Internet Photobook Technology to Enhance Early Childhood "Scientist" Identity

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Abstract There are many influences on a child's identity. Photobook technology purposefully prepared around science explorations presents a modern opportunity to repeatedly trigger memories that reinforce the "me, as scientist" viewpoint. Semi-structured interviews at 6 and 8 years of age were conducted with a child who was the subject of a photobook of everyday science activities to gain insights into his thinking about the nature of science and how he interprets his younger self participating. Interview data were recorded, transcribed and analyzed using dimensions from the previously established parameters for the nature of science. The child's statements about his participation in the photos were matched to these dimensions to consider how he sees himself "doing science" through his early years. Preliminary findings suggest that the child recognizes elements of science and regards himself as an active participant. In both interviews, the child reinforces these views by the opportunity to revisit the experiences in the photobook. Affective components may motivate further science involvement as well: the child enjoyed the time and attention that the photos and discussion provided; the child took pride in being the subject of a book. This case study suggests that there is a fertile field of research to investigate how, for whom, and in what ways internet photobook technology may enhance a child's developing identity as capable science explorer.

Keywords Early childhood science · Photography and science education · Identity development in children · Family science involvement · Conversation and science learning

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Introduction

> …my use of visual data evolved over time. However, since I have found how useful this technique can be to my professional work, it has become a natural vehicle to gain insights into the way individuals perceive specific concepts, as well as certain aspects of their learning environment. I hope that the ideas expressed in this essay will be a catalyst to help you and others find ways to also use visual data as an instructional aide or a research tool.
>
> (Barman 2009, p. 130)

The availability of internet photobook technology presents the opportunity to bring together research in early childhood science education and the use of photography in teaching/learning. I wanted to explore this combination within the framework of previous studies in science with young children. This paper suggests that the use of internet photobook technology may support the childhood development of an identity as "me, as scientist." Wenger (1998, p. 56) has discussed the reflexivity of identity and participation. Therefore, such an identity may facilitate children's comfort and participation in science activities. This paper reports specifically on an exploratory case study that shows promise for this technology use and suggests a fertile area of further research. While this research took place in an informal science education setting—the home and family unit—the technology has potential applications wherever photographs may be organized with a theme and uploaded to one of the many internet sites that produce photobooks.

I have found that while studies have confirmed the usefulness of photography as a tool, there is as yet no research on the scientist identity potential for digital photobook technology now available as a setting for a collection of photographs. How would a child respond in conversation about himself as a scientist while viewing a photobook with selected pictures of himself playing in familiar settings? What does the child think of as science? What happens between the child and adult during the viewing activity? In what ways could this tool further the child's science education?

Science Education and Photography

Photographs have been used at every level of schooling to teach science. Krauss et al. (2010) employed single photographs as efficient case studies in a college biology course in the US to stimulate student questions that led to better ownership of course material. Krauss and his colleagues concluded that the personal connection between the instructor/photographer and the students viewing and discussing those photographs assists students in retaining course material. Eshach (2009) worked with both high school students and teacher trainees in Israel to test a teaching technique wherein students create and interpret their own photographs. He found that the combination of visual and verbal processing in this method allowed him to gain insights into the science misconceptions of his students. At the early childhood level, immigrant children in a Pennsylvania, US preschool were given disposable cameras to take pictures of what was important to them (Keat et al. 2009). Photo narrations by the children to the teacher followed. Researchers found that the children assumed a more powerful role in the relationship with the teacher as they talked about their photographs of home and their cultural perspectives for the teacher's understanding. The photo narrations activity also provided English language competency information. Hoisington (2002) describes the results of her use of photography during building activities in her Head Start class. Pictures helped children to revisit and extend their investigations, to reflect and articulate their experiences, and to analyze and synthesize data. Although she does not state it explicitly, her use of photographs also changes the way she organizes her teaching to capture and sequence photographs for the benefit of her students. Trade books, such as *Picture This* (Entz and Galarza 2000), *Teaching with Digital Images* (Bell and Bull 2005) and *Picture Science, Using Digital Photography To Teach Young Children* (Neumann-Hinds 2007) each provide instructions for how to use photography in science teaching attest to the increasing interest and usage of photography in science education. The themes that emerge from these writings are that (1) digital photography is accessible, both in cost and ease of use and (2) that photographs facilitate learning/teaching conversation.

Digital Photography and Digital Photobooks

Digital photobook technology on the internet presents an evolutionary step in the educational use of photographs. It allows for the selecting, annotating and organizing of pictures to then be professionally printed and bound as single or multiple soft or hard cover books. Photobooks allow for durable and re-readable stories. Most photobook production websites now facilitate the sharing of photobooks through the internet without printing as well. This technology has put the possibility of publishing photo albums as books within the reach of families, teachers and researchers who can create them with themes, thus effectively telling personal stories created with a science education design. People are using photobook technology in increasing numbers. According to the Photomarketing Association (PMA), 44 million dollars worth of photobooks were purchased in 2004 and and 340 million in 2008 (PMA 2009). Another PMA report states that in 2007 "children are the main focus for personalized gifts, greeting cards, calendars, mugs and mousepads" (PMA 2008). This report cites PMA's US Portrait Report in detailing that US consumers spent 7.6 billion dollars on portrait products of which 4.6 billion was spent on children. Families are already engaged in taking and obtaining child-focused photo products. My work in informal science education suggests that parents would find the idea of combining child-centered photography and science education as intriguing as I did. Would this technology work to introduce a science theme into an attractive child-centered photo product to present evidence to the child that the parents (or perhaps teachers) are proud to have her/him be seen and documented as a capable science learner?

Photobooks and Scientist Identity Development—A Potential Early Childhood Science Tool

We are biologically programmed from childhood to need and want to know how things work in the environment that we inhabit—what we call science (e.g. Brown et al. 1988, pp. 9–10; Eschach and Fried 2005; Gopnick et al. 1999, pp. 134–155; McNair 2006, p. vii; Sprung et al. 1985, p. 37). Research within early childhood education concurs that early exposure to science is both natural and desirable. Children continually develop theories about their world (Chaille and Britain 1991, p. 5; Conezio and French 2002; Fleer and Robbins 2003; Lind 1996, pp. 2–12; Metz 1998). Adults mediate children's theories (Crowley and Galco 2001; Doverberg and Pramling 1996, pp. 34–39; Fleer 2009). The most common form of mediation is conversation (Callanan and Oakes 1992; Crowley and Galco 2001; Hart and Risley 1995; Sfard and Prusak 2005). The key attributes of identity are succinctly defined as how one sees oneself and how one is seen by others as a “certain kind of person” (Gee 2001). It has been argued that it is how one identifies that allows a person to consider functioning within a context (Wenger 1998, pp. 149–158). Thus, if we want our children to be recognized and to recognize themselves as scientists, adults with an interest in welcoming children into a community of science participants should provide exposure and conversation that facilitates such an identity.

Family members, usually parents, generally have the greatest opportunity to talk to their young children from birth. Sfard and Prusak (2005) state that identity development is encouraged through communication with others. They suggest that “identities may be defined as collections of stories about persons or, more specifically, as those narratives about individuals that are reifying, endorsable, and significant” (p. 16). Crowley and Galco (2001) conclude that, “In terms of future classroom success or later choices about science as a career, the most important outcome of everyday parent–child scientific thinking may not be the content children acquire, but the interest, habits, and identity they form as someone who is competent in scientific thinking.”

It is this potential identity formation as a competent scientific thinker that the adaptation of photobook technology may support. Photobooks extend photographs beyond documenting, analyzing and presenting science activity to the realm of a storytelling book. By designing a book to highlight a child’s exploration as scientist that can be displayed and repeatedly read, would I find evidence of recognition of “me as scientist”? And concurrently, what did the child understand as science?

It may then follow that creating digital photobooks featuring young children engaged in exploring their world could support their development as people who are seen and who see themselves as “me, as scientist.” With this identity, children may comfortably function as science learners within school science contexts and continue as informed lifelong learners or professional scientists.

With previous insights in mind this exploratory case study began with the question: How and in what ways could the use of internet photobook technology enhance a child’s identity as a young scientist? It is important to state that there are many influences on a child’s identity and that what I have researched here is the potential of only one step in the evolution of photography to contribute further to science teaching and learning.

Ever since 1837, when Daguerre’s methods for developing and fixing an image made photography more widely possible, photos have been recognized for their educational as well as artistic value. While school and class portraits attest to a desire to create a formal record of children’s growth, digital photography, introduced to the general public in the 1980’s, has transformed the ability to capture many more activities frequently and inexpensively. Internet photobook technology allows us to organize photographs into stories from our snapshot memories. By uploading and sequencing photographs and text, we present a vision of our subjects, which is professionally printed and bound to become a “real” book on the shelf. Children leafing through these books with adults or eventually reading by themselves see what the adults in their lives have valued to both photograph and print. They learn what these adults literally choose to focus on. From a research standpoint, this technology presented an opportunity to begin an investigation of how a photobook designed around a child’s exploration of his world might impact on the child’s identity of himself as a scientist. The central question to explore was, how and in what ways might this photobook contribute to scientist identity in a young child? Within this overarching question, I had to ask what the indications of identity as scientist were and what science meant to this child.

Method

There are two components to this research:

(1) construction of a photobook where the photographs are selected to present a range of that child’s explorations in his/her natural environments
(2) conversation around the reading of the book with the child pictured

An Action Research Model

I used an action research model to consider the potential of the photobook tool to assist in identity development. It seemed an appropriate and authentic method for this investigation. In action research a teacher who prepares both the environment and curriculum chooses to study one aspect of her work with the goal of understanding and improving her teaching and her students’ learning (Souto-Manning and Mitchell 2010; Spiegel et al. 1995). Transferring this model to an informal science setting—in this case a home—I designed an intervention—a photobook—and then used it in situ as a grandmother-grandson project to explore its potential to support scientist identity in a young child within the family setting. I worked within the boundaries of my overlapping identities as a science education researcher and a grandparent. As I listened to the questions and comments my grandchild posed in response to my choices, I noted his responses. These responses informed me about how to alter both my photobook construction and my conversation to evoke scientist identity gently, mindful of the affection within the relationship that has led to trust.

The importance of the family in science education cannot be underestimated. “A good guide, a good model, young or old, whether friend, teacher, parent or other relative, is also considered important to the furtherance of a child’s success in learning and consequently in living.” (Williams 1984, p. 8) To explain this from a biological standpoint, we have a long period of dependence in which to mature and learn a great deal necessary for our survival. It is a lot of work to raise children and alloparenting (help from others with a close relationship—like grandparents) makes the work feasible (Gopnick 2009).

There is a precedent for family action research that I discuss later in the Methods section. I would like to argue that my bringing my own habits of mind as a science educator to grandparenting is an asset in this case. It is very much the relationship within families and potentially classrooms that make this tool effective for identity development, for it is within trusted relationships that positive identities are formed (Brazelton and Sparrow 2001, p. 215; Crowley and Galco 2001; Rutherford and Ahlgren 1990, p. 171). One must care to be accepted within a context—in this case, the context of capable science learner. In Fig. 1, I present an example of my approach with one photograph and the questions I employed as my part of a conversation I had with this grandson as we looked at his picture together.

This grandchild, 3 years old at the time, found the egg that he is holding in the photograph on a walk in a wooded park near his home. This picture was included in a photobook I made entitled, “Tell me how you know.” Reading the book several months later, I asked these questions as we got to the page with this image.

Fig. 1 An example of the family science researcher’s experience in using a photograph to stimulate conversation

To the child:

- Do you remember what you found when we walked in the woods? (recalling experience, describing and classification)
- How did you think it got to where you found it? (theorizing, imagining, describing)
- What size bird would have laid that egg? Could it have been that little brown bird like the ones out front? Was it an ostrich? (prior knowledge, comparing, estimating, describing, humor)
- What do you think happened to the eggshell when you left it on the ground? What do you think happened to the baby bird? (theorizing, predicting). How could we find out more about the birds in the woods and their eggs? (learning to use information resources).
- Why was it important to wash your hands when we came home? (health and safety habits)
- Were you a little scientist? What were you doing that a scientist does? (identity development, prior knowledge).

Participants

The Researcher in This Study

I have worked for over 30 years in the realm of informal science education. I developed a program which grew nationally around the United States with the partial support of the National Science Foundation and then spread somewhat internationally. During this time, I have studied and written on various aspects of informal science education design, family science participation, and the interaction of informal science education in partnership with schooling (Katz et al. 2010; Katz 1988a, b, 1990, 1996, 2001, 2006; Katz and McGinnis 1999; McGinnis et al. in press). I am currently a Research Associate at a university where we have been studying the outcomes of including an informal science education internship within the elementary teacher education program. I am also an active grandparent who is an avid photography hobbyist. I began utilizing internet photobook technology in 2007. As both my professional and family identities overlapped, I came to consider how family photobook technology might be adapted to science education.

In this particular investigation, I believe I am reporting in an authentic and appropriate manner. Among those who study families, family participation is valued. Cox and Paley (2003) suggest that research on families should consider them as multi-level (generational) systems and that research should be longitudinal. There is precedent for research by members within families. Turnbull et al. (1998) present six levels of participatory action research along with the advantages and challenges they bring. In their level 6 (highest) they present families as research leaders with researchers as ongoing advisors. The advantages to high family participation include relevance of the research, increased acceptance of research procedures, and a minimizing of logistical issues. I engaged in this research because of its relevance to me both personally and professionally, because it was accessible, and because I am prepared to do so.

> Our insights about family processes and structures are affected by our membership in particular families, by the lives of those we study, and by what we care about knowing and explaining (Allen 2000).

The Child

In the exploratory case study presented here, my oldest grandson, David, is the child participant, both subject of the photography and interviewee. His home is enriched with books and toys. His parents both have Masters degrees in science. As my eldest grandson he was the subject of an extensive collection of photographs from his birth through the age of five when I decided to make the photobook. He agreed to be interviewed at the age of 6 and again at 8 so that I would have the opportunity to consider his development as I thought about the usefulness of the photobook as a science education tool. He consented to the research when I explained what we would do and how I would use the information. I explained that his consent, as well as that of his parents was essential to the research. His smiles and eagerness conveyed to me that he was pleased to help out and to have the attention again focused on him through this book and research conversation.

Procedures

Creating the Photobook

Using a digital camera, I have documented David's growth and participation in family gatherings. Digital cameras and large hard disk drives have facilitated my taking many hundreds of photographs of this grandson. I selected 37 of them to design the photobook that I titled, *Look at Me Learning Science*. At the time that I prepared the photobook I selected a range of pictures that displayed curiosity, manipulation, and other common experiences that I interpreted as building the skills and habits of mind that result in science.

As part of the photobook creation process, I chose an 8 1/2 × 11 landscape format and determined that the book would contain 20 pages, the minimum number for a full color bound book produced by the vendor website for a given price. Within this format and my desire to portray a variety of age points and sequences as well as the characteristics in the above paragraph, I placed the 37 photographs in ascending age sequence to tell a story of curiosity and manipulation as part of development. For captions, I wrote only questions, samples of which accompany the photographs in Table 1 below. The questions were formulated to present a balance of types of questions with an emphasis on those that were open-ended and encouraged a broad range of possible response (American Association for the Advancement of Science 1993, p. 285; Blosser 1991; Howe 2002, p. 111)

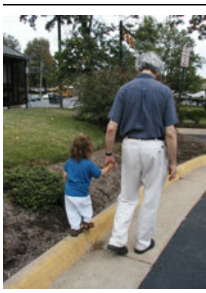
I later considered how the photos chosen represented three ranges of important contexts of science education:

(1) the indoor and outdoor environments that comprise a child's world
(2) the explorations by oneself and in collaboration with others that illustrate the individual and social aspects of science investigations
(3) the general playing/exploring settings of childhood and the explorations that take place in designed informal science institutions—in this example in a science museum and a butterfly garden.

Table 1 presents a sample of the photographs, categories and captions from this analysis

After the photobook was completed in 2008, I asked David if he would be interested in letting me interview him as we talked about his ideas when we read the book together. I asked him to describe the activity pictured in his own words; I asked him if he thought there was any learning in that activity; I asked him what he thought was science. In 2010, I repeated the semi-structured interview to gain insights from any changes. There were instances in both conversations when David initiated a question relating to my questions or about the research itself. Because of our continued relationship, I believe that David was comfortable interrupting and sometimes changing the course of the conversation temporarily. For example, at one point he said, "Grandma, I have a question. How are they seeing what we are looking at? They don't know what we are looking at" (2010). He was confused about how the recorded conversation would have meaning to anyone else. I explained to him that I would type up the voice recording and match it to the pictures or describe them when I wrote about him, so that people who might be interested in using this for science education would have evidence. "Why do you want to give evidence?" he continued to ask. I responded that in this case, evidence could help people make decisions about whether photobooks would be useful. Satisfied, we continued to look at photos together and talk about his activity in the photos and how he understood them to be science and himself to be a young scientist. The

Table 1 Three context pairings for photographs

Photographic examples with their captions from the photobook	Alternate classifications to describe the settings of the selected photographs	Number of photographs, (N = 37 total for each pair)
 Is there any science in eating?	Indoors	23
 What did you learn about snow? How?	Outdoors	14
 Could you learn science by playing with trains?	Child exploring on his own	28
 What do you have to know to place a plant to grow? How did grandpa help you?	Child exploring with others	9
 What are you doing here? What does practice have to do with science?	Playing or exploring in everyday settings	28
 What science tool did you use here? How did you use it?	Playing or exploring at a informal science institution (here, a butterfly exhibit at a local botanical garden)	9

conversation revealed that David did not yet connect the concept of my developing evidence with his own use of evidence, but he did have a concept associated with the term.

Analysis and Results

David continually affirmed to himself and to me that he was engaged in science as he understood it. There was an indication that his concept of science changed from a body of facts to a way of knowing during the 2 years between our interviews. (Note: "D" refers to David and "G" to Grandmother):

When viewing a photograph of his trying to walk on a narrow sidewalk edge (2008).

> G: Do you think that practice has anything to do with science?
> D: Yeah, you practice and learn!
> G: How is practicing science different from practicing blowing up a balloon?
> D: Cause it's much more important.
> G: Okay, tell me why. Why do you think science is important?
> D: Because if you don't learn it, you don't know a lot of things in science, 'cause a lot of things have science in them. You won't know a lot.

When looking at a photograph of him building a snowman, he said (2010),

> D: I am learning that I can actually shape that—that it's not going to collapse or fall through my fingers like water does. I'm learning that I can make it into shapes and put it on top of each other.
> G: And tell me why that is science.
> D: Because I am figuring thing out.

In seeking to gain insights into if and how this child sees himself as a scientist, I wanted to have a better understanding of what science meant to him. For this I utilized the Views of Nature of Science (VNOS) categories as an analysis strategy for what he considers science. Nature of science research has offered lists of categories for discussion of what science is, sometimes compared to differing views provided by investigating nature of science among groups of learners (Crowther et al. 2005; Lederman et al. 1998; McLelland 2006). I used the description by Crowther et al. (2005) of attributes as concise statements that had been described for younger children. In Table 2 below, the nature of science categories are provided to the left and samples of David's relevant comments to the right. Some of his comments are negative examples in that they provide evidence of alternate conceptions.

Findings

David describes his sense of himself as science learner. He repeatedly talks of figuring things out and distinguishes this from prior knowledge. He has a sense of experimenting, of trial and error, but not yet a sense of systematic procedures, which are not pictured in the book. This information can assist his family and teachers to know what he needs to develop a sense of science closer to a scientist's viewpoint. This has been one benefit of the action research model where the information derived by the participants can lead to my improving both future photobooks and my conversations about science and developing scientist identity. For example, David said in response to one page of three pictures, "The only way to show that I was a scientist, with three pictures together, you can see that I was figuring out how to use this [toy]….They can't be separate pictures. They don't look like I am doing anything. They have to be together." In terms of a photobook, I will now think about the effectiveness of including a particular sequence of pictures as an illustration of early scientific investigation or I may choose to provide different visual or written clues to the rationale behind the sequence. In terms of conversation, I will begin to ask more about ways in which we find and interpret evidence.

David's views on the nature of science are limited. He seems to see opportunities for science in both natural and designed materials, like flowers and toy trains. Although he doesn't use the word "evidence" for his trial and error learning about magnetic connectors on the trains or the use of spoon as a lever, he assumes that he will figure something out from concentrating on the situation at hand. He recognizes that adults scaffold his learning and enculturate him with language. Although David is open to multiple ways of figuring things out, he does not yet have a notion of the kind of experimental science that applies a systematic approach to separating variables and testing for trial outcomes. The evidence I gathered leads me to interpret that David thinks of himself as a scientist because he is curious and a problem-solver. He has maintained his curiosity at least to 8 years of age, into his first school years, and although he gives me examples of alternate conceptions, he states that new information that scientists find can change ideas, as with the dinosaurs.

The photobook does facilitate conversation. I asked David to consider how his playtime activities could be interpreted as science and he turned his attention to that consideration. I was able to listen to his thinking about what science means to him and how he thinks he participates. I was also able to identify alternate conceptions that could guide me to offer him experiences in the direction of currently accepted explanations. Our conversations followed the photographs as jumping off points for his verbal

Table 2 Child's comments analyzed by NOS attributes

Nature of Science Attribute	Sample, David's Relevant Comment (Author comments in italics).
Empirical nature of scientific knowledge (observation of the natural world)	When viewing a photograph of himself at the age of about one and a half manipulating a small toy: *What do you think you were learning here*? What you can do with things. *What does that have to do with science*? I don't know. (2008). When viewing pictures of himself in a high chair with food and a spoon: In these pictures I am learning science by figuring out how to use the spoon to eat my food. How I am supposed to pick up food. *So, you are learning to use a tool?* Yes. *Do you see that as part of being a little scientist, too?* I am [also] figuring out that it makes noise. *You were good at that!* How much noise it makes. (2010)
Observation, inference and theoretical entities in science (claims vs. evidence)	When viewing a photograph of a wooden train system: It [the train] goes up and down. *And when does it go faster?* On the way down. (2008) * * * *Did you learn that playing trains?* Yeah. *So you learned science by playing with trains*? Yeah. (2008). I am figuring out how the trains connect, like how the magnets work and if I put it the wrong way, it's not going to connect.(2010)
Scientific theories and laws (specificity)	No evidence.
Creative and imaginative nature of scientific knowledge (human activity)	Viewing a photograph of himself and his grandfather planting annuals in the spring: *What does the plant need?* Water. *Is that all?* Sunshine. *Why does it need sunshine?* Give it light to see. To see? They might. (2008)
Theory laden nature of scientific knowledge (beliefs and prior knowledge)	When viewing a photograph of his gardening activities, *I asked the difference between gardening for fun and learning science*. Well, gardening for the fun of it is you already know hot to do it, so you do it. You're not thinking about the science—how do I do this thing? You are not trying to figure out because you already know how to do it. So, you are just doing it for the fun (2010)
Myth of scientific method	*Is there any special way that you figure things out if you are a scientist?* I don't think so, unless you use a tool or something. It's not really a special way.

Table 2 continued

Nature of Science Attribute	Sample, David's Relevant Comment (Author comments in italics).
Tentative nature of scientific knowledge (subject to change)	When looking at a photograph of his visit to a dinosaur exhibit: What happened to the dinosaurs? Well, that was before because now they know. *Do you think there might be something new to find out?* Yes. (2010)
Social-cultural embeddedness of scientific knowledge (within cultural milieu)	When looking at himself playing with me: *Did you learn anything from me?* Yes. *Like what?* Like new words. *What does that have to do with learning science?* That you can help.

descriptions of what was happening, what was different now, and what his theories were.

David is happy and willing to participate in this research activity. When we looked at an earlier version of this paper together, David asked me if I would interview him again at age 10. I asked him why, and he responded that it was fun and I could continue to see how his thinking was changing. My 8 year old grandson is setting a research agenda!

Discussion

Making a Photobook Aimed at Supporting "Me, as Scientist" Identity

Creating educational photographic records is not new. There is evidence both from research journals and trade books that photography is useful in the classroom for both teaching/learning and assessment (Entz and Galarza 2000; Hoisington 2002; Park and Bell 2005; Neumann-Hinds 2007; Eschach 2009; Keat et al. 2009; Krauss et al. 2010) but using photobook technology to present a story of "the young child as scientist," has yet to be more fully investigated. This technology brings together three processes to create a science education tool:

- the taking and organizing of photos featuring the explorations of a child
- the making of a professionally printed and bound book as a personal artifact with intrinsic (self) interest
- the repeated reading of that visual story to support the child's own vision of himself as a capable explorer, as well as the adult's vision of the same

The components of this case study were assembled over 6 years. Since the photographs were taken of David's usual activities as a young child and not a regularly occurring designed science education setting, I would like to suggest that there is an opportunity to connect play and its application to science. I began this paper with the shared assumption that science exploration for young children is natural. I believe it follows that children's play activities can be viewed as those that can lead into established science (Brown 2009, pp. 100–103).

My contribution to the use of photography in science education is that I have adapted a relatively new technology by bringing both a science educator's/researchers' background together with personal family experience in the important informal environment of the home and family. These experiences and studies suggested to me that creating and using a photobook to further science education goals was possible. The flexibility of creating one's own book allows creative freedom to write captions and select pictures at will.

The technology requires further research. Is there interest on the part of the general public to create photobooks with a science education goal? What impact would photobook creation have on adults not in the science education community?

Would the informal science education community need to create guidelines for photobooks that enhance scientist identity? What would these look like? What research protocols could be established to investigate the use of these photobooks within the home? Is it possible to follow its effects in preschool science participation or children's questions and how? Can this family-based case study in photobook technology be transferred to the classroom for individual or group use? How and in what ways would it change?

Could the effects of this technology use be expanded by having the child participate more fully in choosing to be photographed at certain times? Could the child engage in the photobook production process by defining and choosing photos? Could the child help set both the photography and image selection criteria through discussion with older siblings or adults (parents, grandparents, guardians, teachers).

Would such photobooks facilitate reading? Could the photobooks be crafted to stimulate further research on the child's part in specific science areas?

Photobooks as Conversation Facilitators

David liked to read this book about himself. He answered questions and asked some of his own when we read. He was interested in revisiting his experiences and commenting on them. He was curious about the research process. Reading a book in a pair is a warm and comforting experience of both existing relationship and relationship building. The photobook in this research was adapted to literally focus adult attention and childhood experiences on what it is that creates a socio-cultural environment conducive to learning science. Research within the home environment tells us that creating such an environment may well lead to attitudes and interest that support a child's future (Bloom 1982; Tamir 1991; Gottfried et al. 1998). Within the trust and the modeling of close family relationships, a child absorbs the values and patterns that make up a developing identity (Brazelton and Sparrow 2001, p. 215; Crowley and Galco 2001; Fender and Crowley 2007; National Science Teachers Association 1994; Rutherford and Ahlgren 1990, p. 171, Sanford et al. 2007; Valle and Callahan 2006). Photographs facilitate conversation and photobooks give a targeted collection a place to be and may contribute a sense of importance and permanence that facilitate continued conversation. I witnessed David reading a photobook to his younger sibling. This was an effect I had not considered. When a book remains accessible to multiple children, the possibility exists that children will share it and further conversation without any adult intervention.

I found preliminary evidence that the designed photobook was a successful vehicle for encouraging "me, as scientist" identity. At 6 and 8 years of age, my grandson had a limited sense of the nature of science, but he does have confidence in his ability to learn about his world, consult with trusted adults and accept that science knowledge is tentative. It is possible to critique this investigation by questioning the attribution of any effect to the photobook. The child in this case is being raised by a well educated family that is involved in science and science education professionally. It is likely that the children and grandchildren of science educators and teachers of young children in general will be immersed in activities and conversation that will help the children to grow as curious confident humans. However, this initial investigation suggests that for them, as well as others, documenting and discussing what could be seen as science activity with a tool that encourages pride in these endeavors may strengthen the effort to provide the personal and societal goals of science education. Rutherford and Ahlgren (1990) state, "Even today, it is evident that family, religion, peers, books, news and entertainment media, and general life experiences are the chief influences in shaping people's views of knowledge, learning and other aspects of life" (1990, p. 171). The photographs that most people take of their children's activities can be viewed as everyday experience in how the world works. These experiences can be approached as early science if the adult who is viewing and reliving these experiences with the focus child (or perhaps children) chooses to do so. Using techniques recommended for quality science teaching in both early childhood and standards established for school teaching, photographs can trigger conversation that supports the learner's confidence in his/her ability to see him/herself as a capable explorer and thinker. Defining identity as how one sees oneself and how one is seen (Gee 2001), a photobook facilitates these two facets by design. The photographs are evidence that the subject is "seen," and the conversation, centered around "self as capable explorer" as described in this paper, may well help to internalize the self-concept portion of identity as rereading provides a continued mantra of "me, as scientist." I hope that those with access to larger groups of families will adapt and replicate this study for further insights among children in different circumstances and at different ages.

Just as creativity and imagination are recognized within discussions on the nature of science, I offer this project and investigation as my own creative effort in science education. I believe that there is sufficient evidence to suggest that the use of internet photobook technology may be successfully adapted to a purpose which furthers a very important part of science education—the ability of children to be seen and see themselves as capable science learners—and to therefore participate more fully in a community that values learning science.

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