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School Libraries as Innovation Spaces: Stimulating Creativity and Inventive Thinking

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Introduction

Innovation requires a combination of effective problem-solving skills and persistence to find a viable solution to a problem (Small et al., 2011). Prather and Gundry (1995) consider innovation as a way to solve problems that enables achievement of a new, higher level of performance. Perhaps the most comprehensive and widely-used definition of innovation is offered by Rosabeth Kanter (1985). She defines innovation as the generation, acceptance, and implementation of a new idea, process, product, or service or a new or improved version of an existing product or service.

While our schools often focus on curriculum, standards, and testing, educators (and particularly school librarians) need to provide opportunities for students to be creative, innovate, and explore their ideas. While librarians teach inquiry skills, they need to transform their libraries into innovation spaces in which all children can use apply those inquiry skills to seek solutions to challenges, both individual and global. The purpose of the pilot research study described in this article is to help us better understand the motivation and information needs of young innovators so as to better serve those needs.

Background

Small, Costa & Rothwell (2011) present an Innovation Continuum that explains the progression from creativity to innovation to entrepreneurship (see Fig. 1). Creativity, the most basic form of innovation, is the creation of something new or novel, even if it is only novel to its creator (Weisberg, 2006). We can think of all children as creative, especially because they have not yet learned to censor their thinking or limit their imaginations. Activities that foster children's creativity can range from story development to creating computer graphics. Creativity can end in itself but for it to lead to innovation, it not only has to be a novel product or service or improve an existing product or service but it also has to have utility and leads to both acceptance

and implementation by others (Kanter, 1985). An example might be a child uses her ability to develop a story and computer graphics to create an original story with computer-generated illustrations and hand binds it so that the school librarian can place it on a library bookshelf to share with other students. Innovation leads to entrepreneurship when (1) the innovator seeks a market and (2) the innovation is accepted or adopted by others as a result of active dissemination (Small et al., 2011). To take our example one step further, the child submits her original illustrated manuscript to a publisher for the commercial market.



Fig. 1. The Innovation Continuum (Small et al., 2011)

Youth tend to form somewhat smaller social networks, generally with their friends and family and children form even smaller, more intimate social groups, largely with adults and some child friends. Children and youth are more intrinsically motivated than adults to explore the creative potential of the innovation process. They often perceive innovation as part of a larger learning process and view it through a more altruistic lens than adults (Small et al., 2011).

School libraries offer an ideal environment for fostering discovery and innovation, acting as “inquiry learning labs” to foster curiosity, exploration and creative thinking (Knodt, 2010) or what Bush (2008) calls “learning playgrounds.” Librarians are particularly well-suited to lead this effort because they are (1) often the ones who teach digital literacy and technology fluency, critical elements for the support of children’s creativity and inventiveness (Lewis, 2009); (2) able to tie these activities to common core learning standards across any and all subject areas, rather than focusing only on a single subject area; and (3) with a flexible schedule are able to accommodate more diverse activities and experimentation.

However, we know very little about (1) the factors that contribute to or support a student’s innovation process, (2) who and what motivates or demotivates that process, and (3) what role information resources and services play in facilitating the process. This article describes a research study conducted by researchers at Syracuse University’s Center for Digital Literacy (CDL), in collaboration with a statewide Invention Convention an event designed to develop, encourage and enhance imagination and critical thinking skills in K-8 students through invention, innovation and entrepreneurship. This pilot study sought to explore the motivational supports and information needs of young innovators in grade 4-8.

Research questions for this pilot study were:

1. In what ways does participation in innovation activities affect student motivation?
2. What information resources and technologies facilitate students’ innovation process?
3. What information skills are most important for young innovators?
4. What roles do teachers and librarians play in supporting and facilitating student innovation?
5. Is there a relationship between participation in innovation activities and interest in STEM learning?

Methods

Recruitment of Participants. Email and Web site messages were sent to teachers and parents from schools involved in participating in their state's Invention Convention to solicit parental permissions for their children in grades 4-8 to participate in the survey and follow-up telephone interviews. Only students who had proceeded from their school invention fairs to the statewide convention were solicited.

Research Instruments. This research study used online surveys and telephone interviews to collect data from grade 4-8 participants in the state Invention Convention. An electronic, three-part survey was developed and implemented using SurveyMonkey.com and IRB approval was awarded.

The online survey consisted of three parts. Part 1 asked for demographic data (grade level, sex, school and location), a description of their invention, and why they created the invention. Part 2 focused used an adapted version of Deci & Ryan's Intrinsic Motivation Inventory, providing participants with a list of 21 items describing how they felt as they were creating their inventions (e.g., "I created an invention because I wanted to," "I put a lot of effort into inventing," "I felt confident in my ability to create an invention"). Part 3 focused on information resources and technologies used by students. The first question provided a list of 15 resources and technologies (ranging from books to videos to databases to libraries) and participants were asked to rate how *useful* that resource was to them as they were creating their inventions. The next question asked participants to similarly rate human resources (e.g., mother, father, friend, teacher, librarian). The next two questions required participants, using a list of 13 information literacy skills (e.g. "asking good questions," "finding the best information to answer your questions," "taking good notes"), to rate first how *important* each skill was to them as they were inventing and then to rate how *proficient* they were at each skill. The final question asked "Do you plan to keep inventing things even if you didn't win a competition or go to the Invention Convention? This question was intended to support how intrinsically motivated they are for invention activities. The last item asked if they had any other information they wanted us to know.

Procedures. Once parental permission was received, an email with the URL to the survey was sent to the parent for their child. Only data from students whose parents returned a signed permission were included in the study. After the survey period was completed, 11 students were selected from those who completed the survey and had parental permission to participate in the telephone surveys.

Results

A total of 88 parents signed and returned a parental permission form. Once parental permission had been obtained, each child was required to consent to participate before they could proceed in the survey and in the telephone interviews.

Surveys. Sixty-seven children in grades 4-8 agreed to fill out our online survey. However, five dropped out of the study and 62 completed the survey on SurveyMonkey.com. A total of 62 children participated in the young innovator survey, 58% girls, 42% boys. Eight percent (5) were in grade 4 and in grade 8 in schools in the state. The remaining 84% were divided as: 37% in grade 5, 26% in grade 6, and 21% in grade 7.

At the beginning of the survey, responders were asked to describe their inventions. This allowed the researchers to get a sense of the scope and complexity of the invention projects and

gave participants an opportunity to share their pride in their work. Below are some of those descriptions, in the words of these 4th through 8th grade inventors. Several reflect the delightful perspective of a child while others display a remarkable sophistication, social sensitivity and altruism. A complete list of survey participants' invention descriptions is available in the Appendix.

- The Pocket Chiller is a device that allows people with diabetes or any other disease able to keep their insulin or other medications and snacks cold inside a device that fits in their pocket and lasts up to 6 hours.
- I created an invention that clears snow and moss off your roof by use of ethylene glycol dripping through a drip system. I later switched it to propylene glycol because ethylene glycol was toxic to the environment.
- The invention I created is a pair of socks with fluffy balls on them. The number of balls on the sock allows the user to determine the color of the socks (1 ball equals blue, 2 balls equal brown, ETC.). The balls could also be used to hold the socks together in the wash, because the balls are attached to the sock with a loop, and the balls of the other sock can fit into that hole and become secure.
- The first invention was called 'The Gaming Station'. The purpose of this is to hold the iPod when you are gaming so you don't have to hold it in your hand. The second invention was called 'Tilt-A-Baby'. It is an attachment for an umbrella stroller to hold the child's head back when the child falls asleep and their head doesn't fall over onto its lap. I ribboned at the convention for both of these inventions.
- Task Bracelet: It's a bracelet that people can record down what they want to remember without writing on their hands or arms.
- My invention is a portable solar powered electrical outlet. You can plug anything into it and it will give you energy instantly. It is solar powered and can be charged to use anywhere. My invention is almost like a mini generator that is "greener" (solar powered).
- My invention is a protective military mask. It prevents any bullets or fragments from the skin. It also keeps you cool in the desert and hot in the cold. This also can hold radios or can fit on a helmet. It does include goggles because they already invented bullet proof goggles. This mask is better than any other mask because it fits the soldier's needs.
- My invention is a small clay model that would represent a remote control that would help people with Treacher Collins Syndrome. People with Treacher Collins Syndrome are born without ears, but have a hearing aid surgically implanted where their ear would be. The remote would have 2 buttons. One that would allow them to hear in broadband, which is when they can hear everything. And one button for singleband, which is when they can hear only one specific noise. And there is a dial to turn the volume up and down. There's also a keychain attached to make it easily portable.
- I have created edible cupcake wrappers. They are an edible liner that the cupcake is baked inside of; you can just eat the whole thing, rather than unwrapping a liner and then indulging. It is made from edible wafer paper. This is convenient, and environmentally friendly.

The survey also asked participants to tell us why they created that particular invention. In a similar study with adult inventors, Small & Backus (2007) found that adults had more practical reasons for inventing (e.g., to earn a living, to gain credentials). In the current study, students demonstrated more altruistic reasons for their inventing activities. This is understandable as

adults have family and career responsibilities that affect their motivation. However, the strikingly sensitive, unselfish, highly personal (and occasionally humorous) motives demonstrated by these young innovators are worthy of note:

- I created it to help prevent pollution from gas and give cars something else to run on. This should keep the Earth from running out of oil.
- Last October during Winter Storm Alfred we were without power for over a week and others were without power for even longer. We had to buy a generator to power our freezer so our food wouldn't go bad. I didn't like having the generator because it cost a lot of money and was bad for the environment. I made my invention because I don't think people should have to spend so much money on an electrical outlet that hurts the environment. My invention would have saved us a lot during the storm. Plus I thought my invention would be useful not just during a power outage but when camping or on the go.
- I am interested in the military and one day I saw this picture of a soldier with a ruined face because he got hit from a bullet in the face and survived. I hoped to protect the face so that this will never happen again.
- I created the R.Y.H bracelet because lots of kids in my school have been forgetting their homework. This bracelet will help them remember their homework.
- I created this invention because my classmate Ryan has Treacher Collins Syndrome (TCS). When Ryan is in the movie theater, and a friend wants to whisper a comment to him, he can't hear him because he has no control over broadband and singleband with the remote control that would change.
- I created this invention due to the millions of car crashes per year. My invention is particularly used to prevent car crashes due to a medical condition of the driver, such as a heart attack or fluctuation of the driver's heart rate.
- I created my invention because in my town about 30% of ALL signs in Hebron are vandalized, and my town's budget doesn't have enough money to repair them. That's when I thought of my invention. Although I had a little inspiration from my mother.
- I created this invention because one winter it snowed a lot and my aunt has a hard time walking even if it was around the corner to her mailbox. I got the idea that some kind of system that would in a way bring the mail to and from the box to her house.
- My brother has a disease called Congenital Adrenal Hyperplasia and needs to have his medications cold at all times and on stand by if he goes into Adrenal Crisis he also has to take meds every day to keep him alive and well. I also know that diabetes is a very scary disease that tons of people have in the USA, and lastly the day I heard about the Invention Convention I had a chocolate bar melt in my pocket.

Intrinsic Motivation: Part I of the survey focused on student intrinsic motivation for creativity and innovation. Intrinsic motivation is motivation that provides satisfaction from the task or activity itself, rather than from an externally-provided outcome. Intrinsic motivation is more likely to occur when a person (1) finds the task or activity interesting and engaging, (2) feels they have choice and autonomy in the task or activity, and (3) perceives they have the competence (knowledge, skills) to be successful (e.g., Deci & Ryan, 1985). To measure the young innovators' intrinsic motivation for inventing activities, 21 items (see Appendix) were adapted from Deci & Ryan's Intrinsic Motivation Inventory (IMI) (e.g., Deci et al, 1994) a multidimensional, validated instrument related to intrinsic motivation and self-regulation and

used to assess a person’s subject experience during a specific activity (e.g., the invention process).

The IMI uses Deci & Ryan’s Self-Determination Theory (SDT) as a framework and contains seven subscales. SDT is a motivation theory that “is concerned with supporting our natural or intrinsic tendencies to behave in effective and healthy ways” (Home Page, <http://www.selfdeterminationtheory.org/>). For this research study, items were selected from six of the seven subscales and adapted to this. The **Interest/Enjoyment** subscale is considered to be the most reliable self-report measure of intrinsic motivation, while the **Perceived Choice** and **Perceived Competence** scales are considered positive predictors of both self-report and behavioral types of intrinsic motivation measures. The **Effort/Importance** subscale is relevant to a person’s motivation, the **Value/Usefulness** subscale is associated with self-regulation and internalizing of an experience; the final subscale, **Pressure/Tension**, is theoretically considered “a negative predictor of intrinsic motivation.” context newest subscale, **Relatedness**, was not included in this study since (1) there was no specific person or group within their schools with whom all children shared this experience and (2) as the newest addition to the instrument, it has not been fully validated (www.selfdeterminationtheory.org).

The adapted IMI required participants to rate 21 statements about the invention creation process from Very true to Not at all true. There were seven Interest/Enjoyment, four Perceived Choice, two Effort/Importance, two Pressure/Tension, four Perceived Competence, and two Value/Usefulness items. Four items were “reverse” items, i.e., they presented the item in the negative (e.g., Inventing is boring; I did not feel nervous at all about participating in the invention program). An example of an item from each of the subscales used is included in Table 1. (See Appendix for full scale.)

| Subscale | Item |
|----------------------|--|
| Interest/Enjoyment | I enjoy inventing things very much. |
| Effort/Importance | It was important to me to do well at inventing. |
| Perceived Choice | It was my choice to <i>participate</i> in the invention program. |
| Value/Usefulness | I think inventing was an important activity for me. |
| Perceived Competence | I think I am pretty good at inventing. |
| Pressure/Tension | I often feel worried when I am inventing. |

Table 1. Intrinsic Motivation Inventory Subscales and Examples of Items Used.

A total of 62 participants responded to this series of items. Scores on items within a subscale were totaled and averaged (see Figure 2). The scores were overwhelmingly positive on all subscales, although there was some indication that a level of anxiety was experienced during this process, as indicated by the lower positive score and higher negative score on Pressure/Tension (this is reinforced during the interviews). In addition, the middle score (Sometimes true), that was not calculated within either the positive or negative scores, was the highest of all subscale mid-scores (20.7%) for Pressure/Tension.

The negative score on Perceived Choice was more than twice as high as all but the Pressure/Tension subscale. This might be due to the fact that some participants indicated that they were required to participate in the invention program in their schools, thus affecting their perceived ability to choose to participate.

| Subscale | Very True/Usually True | Usually Not True/Not at All True |
|----------------------|-------------------------------|---|
| Interest/Enjoyment | 92.4% | 0.6% |
| Effort/Importance | 94.4% | 2.4% |
| Perceived Choice | 82.6% | 11.4% |
| Value/Usefulness | 83.1% | 5.1% |
| Perceived Competence | 81.7% | 3.7% |
| Pressure/Tension | 58.6% | 20.8% |

Table 2. Highest and Lowest Scores for Each Subscale.

In addition, a question in Part 3 asked participants if they planned to keep inventing things even if they didn't win a competition or go to the Invention Convention. Of the 59 respondents to this question, 53 (89.9%) said *yes* while 6 (10.2%) answered *no*. Eight participants chose not to respond. This demonstrates that for the majority of participants, their motivation for participation in invention activities was intrinsic and not due to extrinsic incentives and rewards.

Information Needs. Part II of the survey focused on the use of information resources to support the innovation process. The next set of questions related to the types of information resources young innovators rely on during the invention process. The first question listed 15 places inventors might search for information and asked participants to rate how true it was that the resource was useful to them during the invention creation process. The resources included print materials (books, magazines), media and social media (videos, podcasts, YouTube, Twitter, Facebook), electronic text-based resources (Web sites, databases, email, blogs, wikis, ebooks), and libraries (school, public).

Clearly, Web sites were the most heavily used resource of survey participants. An average of 12% of respondents responded *very true* or *usually true* for print materials (books 18.1%; magazines 5.1%). For media/social media, an average 10% of respondents responded *very true* or *usually true* (videos 22.1%; podcasts 3.4%; YouTube 18.3%; Twitter 1.7%; Facebook 3.3%) while for text-based, electronic resources the average was 22% (Web sites 75.8%; databases 27.9%; email 5.1%; blogs 6.7%; wikis 13.6%; e-books 5%). An average 27% of participants rated use of the school or public library as *very true* or *usually true* (public library 35%; school library 18.3%). Table 3 shows the six most used resources for creating an invention (videos and YouTube were combined). (It should be noted that if this table showed the six resources highest in the *very true* response, public libraries would be higher than videos/YouTube and books would be higher than school libraries.)

| Resource | Total % | Very True | Usually True |
|------------------|----------------|------------------|---------------------|
| Web sites | 75.8% | 43.5% | 32.3% |
| Videos/ YouTube | 40.4% | 16.9% | 23.5% |
| Public libraries | 35.0% | 20.0% | 15.0% |
| Databases | 27.9% | 21.3% | 6.6% |
| School libraries | 18.3% | 13.3% | 5.0% |
| Books | 18.1% | 14.8% | 3.3% |

Table 3. The Six Most Used Information Resources for Creating Inventions.

Nine human resources were also assessed for how much they had helped the respondent during the invention creation process. Since this was largely an out-of-school activity, it stands to reason that the two most helpful human resources would be fathers (73.8%) and mothers (67.4%). Teachers often led invention competitions in their schools and were the point-of-contact for the Invention Convention in the schools and therefore working with students to prepare them for the competition. Table 4 shows the nine choices and their combined *very true/usually true* scores from highest to lowest.

| Human Resource | Combined High Scores |
|-----------------------|-----------------------------|
| Father | 73.8% |
| Mother | 67.4% |
| Teacher | 48.3% |
| Friend | 29.5% |
| Grandparent | 20% |
| Brother/sister | 15.3% |
| Aunt/uncle/cousin | 10.2% |
| Librarian | 5.0% |

Table 4. Combined Very True/Usually True Scores for Human Resources Used While Inventing

21st Century Information Skills. Part III of the survey focused on 21st century information skills and their importance during the innovation process. The first set of 13 items asked participants how *important* each information skill was to them while the second set of items asked participants to assess their *competence* in those same 13 skills. The following table shows the highest (*very true/usually true*) and lowest (*usually not true/not at all true*) ratings for the perceived importance of each skill by 59 respondents.

| Item | Very true/ usually true | Usually not true/ not at all true |
|--|------------------------------------|--|
| Asking good questions | 86.4% | 5.1% |
| Revising your questions so they do a better job of asking what you need to know | 65.6% | 12.1% |
| Knowing where to go to find answers to your questions | 74.5% | 8.5% |
| Using what you already know to figure out answers to your questions | 81.3% | 5.1% |
| Using different resources, such as books and the Internet, to answer your questions | 50.9% | 17.0% |
| Finding needed information | 88.1% | 6.8% |
| Taking good notes | 69.5% | 13.6% |
| Using different kinds of print and online resources to find the information you need | 52.7% | 23.8% |
| Evaluating the information you found in the resources you used | 76.1% | 15.3% |
| Finding the best information to answer your questions | 84.7% | 6.8% |
| Comparing different ideas | 81.3% | 6.8% |
| Choosing the best idea | 89.9% | 1.7% |
| Thinking about what you could do better the next time you | 79.6% | 10.2% |

| | | |
|------------------|--|--|
| invent something | | |
|------------------|--|--|

Table 5. Highest and Lowest Ratings for Importance of 13 21st Century Skills.

The next item asked how good (skilled) respondents were at performing each of these tasks *without help*. Ratings ranged from *very good at it* to *not at all good at it*. Table 6 shows the results; only 21 participants responded to this question.

| Item | Very good at it/ good at it | Somewhat good at it/ not at all good at it |
|--|------------------------------------|---|
| Asking good questions | 81.3% | 18.7% |
| Revising your questions so they do a better job of asking what you need to know | 71.9% | 28.1% |
| Knowing where to go to find answers to your questions | 75.0% | 25.0% |
| Using what you already know to figure out answers to your questions | 93.6% | 6.4% |
| Using different resources, such as books and the Internet, to answer your questions | 81.3% | 18.8% |
| Finding needed information | 87.5% | 12.5% |
| Taking good notes | 65.7% | 34.3% |
| Using different kinds of print and online resources to find the information you need | 75.0% | 25.0% |
| Evaluating the information you found in the resources you used | 84.4% | 15.6% |
| Finding the best information to answer your questions | 87.1% | 12.9% |
| Comparing different ideas | 84.4% | 15.6% |
| Choosing the best idea | 83.9% | 16.1% |
| Thinking about what you could do better the next time you invent something | 90.6% | 9.4% |

Table 6. Highest and Lowest Ratings for Competence for 13 21st Century Skills.

This table indicates that students perceived they were strongest at “Using what you already know to figure out answers to your questions” (93.6%) and “Thinking about what you could do better the next time you invent something” (90.%) and weakest at “Taking good notes (65.7%), “Revising your questions so they do a better job of asking what you need to know” (71.9%). Some studies have shown that children's perceptions of their own competence in a skill area is significantly correlated with their actual performance in the area. This was shown, for example, in a study by Arnone and Reynolds (2009) in which they found a significant correlation between perceived competence in children's information literacy skills and their actual competence as measured by a validated test of information literacy. Some studies have shown that children's perceptions of their own competence in a skill area is significantly correlated with their actual performance in the area. This was shown, for example, in a study by Arnone and Reynolds (2009) they found significant correlations between perceived competence in children's information literacy skills and their actual competence as measured by a validated test of information literacy.

The survey ended with an optional open ended question, asking participants if there was something else they wished to tell us about their inventing experience. Thirty-five participants

chose to respond. Most used it as their last opportunity to state how much they enjoyed the invention process. Here are some examples (see Appendix for full list of responses):

- I love being creative when I invent and I want to keep inventing because I love to do it.
- The main reason why I love and do inventing is because it is challenging, which makes inventing fun.
- I love inventing things that will help people in many ways. This experience was a very good one. I loved the challenges in inventing and sharing my thoughts to people. I will never forget this wonderful experience.
- I am a two year invention convention veteran and this year i didn't get reconized but I'm going to keep working. I still have a journal full of ideas ready to be used
- I had so much fun at the Invention convention, my sister and I plan to go back next year on our own (my school only does it in 5th grade). I don't know what I'm going to invent yet, but I have lots of ideas.

Interviews

Twelve survey participants were purposefully selected for interviews, based on gender and grade level (two from each grade level from 4th-8th grade). Two graduate research assistants were trained in interviewing techniques and both completed CITI training, required of anyone conducting research on human subjects. One research assistant was assigned to conduct the interviews while the other took notes on interviewee responses and demeanor. All interviews were conducted via phone using an Olympus 801 telephone audio recorder. When completed, each interview recording was immediately transcribed for analysis.

Just prior to the start of the interviews, one selected 4th grader was unable to participate; therefore, a total of 11 child inventors (six boys, five girls) were interviewed. All had parental permission to participate in the audio recorded telephone interviews. Each interview lasted from 10-15 minutes. The following participants (names are fictional) were interviewed*: Jacob, 4th grade boy, Fiona, 5th grade girl, Christopher, 5th grade boy, Sabrina and Annie, 6th grade girls, Jonathan and Brandon, 6th grade boys, Jason, 7th grade boy, Debbie, 7th grade girl, Brianna, 8th grade girl, and Paul, 8th grade boy.

An interview protocol consisting of 11 questions was used. Most questions focused on the information and motivational aspects of the invention process. Probes and follow-up questions were included, where appropriate.

The first five questions focused on the invention process and the motivators and de-motivators these young inventors encountered as they went through that process.

How did you first get involved in inventing things?

Most respondents said a teacher (e.g., gifted & talented teacher, engineering teacher) told them or there were announcements at school that there would be an invention fair in their school. Jacob stated that he “liked the idea of getting rid of problems and doing things to make life easier” and that he just “started thinking about problems we face and making a solution.” Paul agreed; he stated that inventing “sounded cool” because he could help make people’s lives easier. Jonathan explained that he “likes figuring out how things work” while another said he was good at building things and that inventing was “in my blood.” Sabrina said her father, who is an engineer, inspired her to invent.

The majority of interviewees mentioned that they were required to participate, although one said she got involved because she thought “inventing was fun.” For some students, participation was voluntary and one 8th grade girl said she got involved because it seemed interesting and novel and because it was related to science and math. This explains the fact that more than 80% of survey participants were motivated to participate because of the intrinsic enjoyment of the activity, even when it was mandated.

What makes inventing fun for you?

It was clear that these students love to problem solve and enjoy the process of inventing. For example, some responses were “making something brand new,” “get an idea and make it useful,” “think of your own solution that no one has thought of,” and “use your imagination.” Christopher stated that he likes to come up with an idea and make it useful in order to solve an everyday problem.

When pressed further, several said it was fun to make things that other people found useful and several mentioned they liked to help people. Brandon added that he and his brother liked taking things apart and building things and added “it’s in my blood.”

Have you ever been awarded a prize or received recognition for inventing something?

Of the 11 students interviewed, six indicated they had received a prize or recognition for their inventions, which allowed them to go to the statewide Invention Convention, where several won prizes from ribbons to a technology grant, from a scholarship to attend a special inventing camp, and from a \$100 savings bond to being named a “Recognized Inventor.” Some prizes were awarded by companies such as the state’s Light and Power Energy Award. Paul related that he felt proud and excited that his invention had been placed on display in the local science museum.

Annie was thrilled to win an award. “It was just so amazing because in third grade... before I won that award, I was kind of upset because I didn’t win an award. I won one at my school, but I didn’t win one at the [state competition]. So winning that award, I just accomplished my dreams because my goal that year was to get one of those prizes from the Invention Convention. I was just so happy, and excited, and I was like, I didn’t believe I got it. It was so amazing.”

For those who did not awarded a prize or received recognition for their inventions, we asked if they felt disappointed, most stated that they were just excited to be at the statewide competition. Brianna noted that, although her inventions hadn’t won any awards, it was “something I can be really proud of” and added “then I realized it’s not all about winning, it’s about having fun.” Jason agreed, noting that he “felt really good” because he had worked hard and accomplished something. Jacob, the youngest interviewee, mentioned that he knew that there were a lot of people with good inventions and stated, “I was just thinking, good for them. I was okay with not getting a prize. I was just glad I was able to bring my invention in for people to look at.” Again, this demonstrates the intrinsic satisfaction that innovation activities have and further supports past research results that indicate extrinsic rewards for intrinsically motivating tasks have little or no impact on motivation unless they are directly related to the task and are tied to effort (Deci & Ryan, 1985).

What is the most difficult thing about inventing for you?

Coming up with the initial idea was the universal response when asked what presented the most challenge when going through the invention process. Jonathan mentioned that his

biggest challenges were making sure his ideas weren't already invented and that they would work; "You have to go through a lot of ideas, make sure they are not copyrighted or invented already. Then you have to make sure they work good." But all of them indicated that they were able to overcome their challenges. Most said they had figured it out themselves but some asked for help, either from a parent or a teacher. It appears that innovation activities like these can stimulate engagement, persistence and time on task.

Do you ever feel nervous or worried when inventing?

Most kid inventors said they don't feel nervous when they are in the process of inventing, although Brianna expressed nervousness with lack of time but immediately blamed herself for procrastinating. In Debbie's case, her invention was being graded and she expressed worry that if she didn't finish her invention on time, it would affect her grade.

For several students, there was some nervousness connected with the State convention. Jason said that with one of his inventions, someone continuously told him that it wouldn't work. He kept working on it and saw that it worked fine. "Glad I didn't listen to that person!" he exclaimed.

Debbie had quite a bit of anxiety about the convention. She worried about winning and about not winning, stating "If we win do we do, what if we don't know what to do and we don't know what to say? What if something happens to us and stuff?" Others worried about presenting in front of so many people. Annie compared it to stage fright but had a solution, "And it's really easy to overcome it once you start believing in yourself. That's all you have to do."

The kids had a variety of methods for overcoming their nervousness. Brianna put her nose to the grindstone, stating "I work on my invention really hard and I practice what I'm going to say to the invention, like, at the invention convention. I practice answering questions and I have other people question me. That sort of helps me feel better, because I know will be able to answer any questions that are asked. And to overcome the nervousness of getting it done on time, I just work on it really, really hard to get it done."

Annie believes in the power of positive thinking. "I just keep telling myself, there's always somebody out there that's better than you. But does that mean your invention isn't good enough? No because, I mean, your invention is good... so maybe it's not the best invention that there's been. But it's an invention that you made, and you think [it] is good. ..And a way to overcome it is saying like, you know there's always somebody better but that doesn't mean mine's not a good invention and you just got to keep telling yourself that. And when you get it, you're nervous and everything, but to overcome it you really have to tell yourself and believe in yourself. And it's really easy to overcome it once you start believing in yourself. That's all you have to do."

Brandon had a more practical method. "Practice with your family and have them ask you questions that you are kind of worried about so you can already have the answer ready for it." Jacob was a bit more direct, "I think maybe just ignoring what other people think. And just, invent whatever you want and use it yourself." But Debbie had the sweetest answer, "Well I take a deep breath and then I sometimes eat a little bit of candy..." The type of anxiety described by these child inventors did not seem to be as strongly connected to the innovation activity as to the fear of public speaking, one of the most common sources of anxiety in both children and adults.

The survey indicated that the Internet was the most highly used resource of those resources listed. Therefore, the next two questions explore the information and information resources these young inventors used.

From where did you access the Internet?

All of the students acknowledged that they had accessed to the Internet and used it as a resource during their inventing process. All but one of those interviewed said they accessed the Internet from home but one said she used computers at both her school library and public library.

In what ways do Web sites help you?

Interviewees said that Web sites “sparked ideas” and had a lot of useful information but also to search to see if their invention already existed and, if so, how they might make it better. Brianna stated that she could “learn about stuff I don’t learn in school.” Brandon asserted “Web sites are all over the world, so you get every bit of information, and if you can’t find your invention, you’re pretty sure it’s not out there.” Several mentioned using Google specifically. Debbie liked using Web sites to find the information she needs, explaining “Websites help us because we don’t need to go, like, anywhere, like, outside of our house and we can get the information that we need, and sometimes when we need, sometimes when we, like, research at libraries, the libraries can be kind of far from our house, so the most convenient way is through Internet.” The acknowledgement of the Web as an essential and important resource during the innovation process appears to be universal with participants.

How do you evaluate the Websites you use?

When asked how they evaluate the quality of the sources they find on the Internet, there was a wide range of responses. Some interviewees said school professionals or family members helped them verify the quality of the resources they were using. For example, Sabrina’s dad helps her by evaluating the source for reliability and appropriateness before she’s allowed to use it. She knows it’s not a good Website “because of something it says on the page, or because if it has a lot of errors in it, or something that’s not true written in it.”

Jonathan and Brandon said they look at other sources to see if the information is consistent across sources. Jacob decides it is a good source if he has had used the Web site before and found the things he found there worked. If he hasn’t used it before, he checks other Web sites or other reliable resources to see if they say the same thing. If more than one does, he considers the new site a reliable source. Jason checks both other Web sites and books to verify the information.

Brianna responded, “Well, you have to find out if it’s a reliable source. You don’t want to take wiki answers or yahoo answers or anything like that because they are just random people submitting replies. You can’t really trust them. But, you can trust sites more like Wikipedia and stuff like that because those are more reliable sites.” Christopher also uses Wikipedia, explaining “(s)ometimes I use [Wikipedia] and because I usually can trust because it’s made by just people who just do that for a job, so I think that’s a good way to do it.” But Debbie disagrees, “Well, in our school, our library, our librarian, always tells us not to use Wikipedia, so we generally stay away from Wikipedia. And then if we’re on a website one thing me and my partner would look for is the author, the dates, and if, we’re going to see if the website actually ends with .com or .edu or .gov or something. So if we know if it has an author, the date it was published, and ends in .edu or .gov, we would normally think that that’s a good website. And

then we would also look at the information about the author, who wrote this article, and then we would determine if it was actually, like, a good website or not.”

It is clear from these responses that there is a lot of work that needs to be done by school librarians in the area of teaching all students 21st century information skills. While some of these students believed they knew how to evaluate the information and information resources they used, their responses indicated that their evaluation methods and their perceptions about evaluation were often flawed.

How do you know you're good at evaluating Web sites?

Sabrina responded “Because I got picked for (State) Invention Convention because everything on my invention and display board was true...” Jacob knows he is good at evaluating Web sites because he checks other reliable sites to verify the information. Jason uses more sophisticated methods of verification. “[S]ometimes I will look at who wrote the article or whatever I’m reading online. I’ll look and see if they are a doctor, or someone who works in that subject area. Sometimes I can tell by the style of writing, and see if they used proper grammar and things such as that. To see if it’s written by just a regular person or someone on a website and are just answering something and don’t care to use proper grammar and things.”

Annie says she knows she is good at evaluating Web sites because she has been using computers for a really long time and knows how to skim content when she first looks at the site. She continues, “Because what I do is I skim through it, and look at what’s happening. I mean, what’s it giving you and what it’s asking you to do and if it seems safe then it’s good. And if it’s not, you shouldn’t, like, use it. That’s what I do. “

Debbie credits her school librarian for teaching her the evaluation skills she needed and demonstrates her knowledge, “...if there isn’t an author, we have no way to know if this article was written by a good, like, a good, reliable author or not and if it ends in .edu it means it’s a website specially, like, set up for educational purposes and normally those websites wouldn’t really say anything like not legit, and then, well, me and my partner, we just go with what the librarian said about having a good, like, website, and we also use what we know, so if a website says something about, like, that’s completely opposite from what we learned about in school, then we would think about, like, which website, like, whether the website or what we learned was actually the right one or not, and then, and we just be patient about these things.” Unfortunately, this was the only such example.

The next set of questions asked about the role their classroom teachers and librarians played during their invention process.

Did your teacher help you when you were inventing?

All of the interviewed young inventors made it clear that their teacher did not help them by giving them an idea or assist them in making their invention. Teachers did help them in other ways, like brainstorming and clarifying their ideas. Fiona said that before the invention, her teacher gave examples of how to evaluate a problem. Paul’s teacher helped him use a machine to cut sheet metal.

Sabrina thought her teacher could have helped them more by providing more information about the inventing process, Jacob wanted his teacher to help him find good sources of information, and Brandon thought his teacher could point out reliable sources and trustworthy Web sites. All of these suggestions from the children themselves provide further evidence that

there are a number of support strategies that the school librarian could provide and that there is a clear role librarians can plan in collaboration with the teachers involved in these activities.

Debbie had a more detailed plan for how her teacher could help. “[T]he way the teacher could help is...organizing something like a school field trip or something to, like, a museum, and then just organize an activity in the class thinking about all the problems that happen to them in the day and how they could solve the problem, and I think that would be a good way to, like, finding projects they could do it on. And, but most importantly it has to be something that they’re interested in, so teachers could organize these classroom activities, especially on the invention convention.”

Did you use your school library or public library to help you during the invention process?

Five of 11 students stated they did *not* use a library to support their inventing process. Of the six that said they did use either their school or local public library, most used it to find books on their invention.

When asked why they did not use a library, the most common answers were that they didn’t have any books on their topic or they preferred to use computers in the lab or at home. As Sabrina stated, “: Because the libraries have a lot of books in them but none of them are really about the inventing process or anything in the ones in my school and the public library so they’re not really helpful.” The overall perception of these young innovators is that libraries are where you go for books but computers were more efficient and faster, had just as good information, and could be accessed from home. Jonathan commented, “Most websites can have just as good information as books. And I have easy access to online services, and I figured it would just be much easier for me.” Brianna stated that her school librarian helped her find some good sources and print out the information she needed. Again, the librarian can help students learn the information skills they need to better use and evaluate those resources.

The young inventors were then asked to think of a way in which a librarian might be able to help them in the future. Again, their perception of the library as a place for books was evident. Christopher said “They might be able to, like, if you ask for a topic or maybe they’ll, like, you can ask about the topic of a book and see if they have any books on that, ” Annie mentioned, “It probably could help us because a library has a lot of books that you can check out or just look at awhile you’re there” and Fiona commented “Well, if you told her what you were trying to look for, if I were doing my fire safety, they might have a book about fire safety in the library.” Sabrina agreed, saying “Because the libraries have a lot of books in them but none of them are really about the inventing process or anything in the ones in my school and the public library so they’re not really helpful.” It is clear that these young innovators perceived that libraries were simply a repository of books and, sometimes, not even relevant ones.

However, some did understand the value of their librarian. Debbie stated, “I think it would be most, a librarian could help us most by, through, like researching, because they know more about, like, which websites are, like, more reliable and they also, like, if you’re having problems with, like, where to find a problem, the librarian can help you look through, like, all the sources that you need.”

Jacob used his public library to find books on ways you “can use materials to make different things that you need for your inventions.” When asked if there were other ways in which the librarian could help him, he said “They could probably help me find books, on what to do, or how to make an invention.”

The next three questions focused on the future.

What do you want to do when you grow up?

It was clear that this experience was both influenced by previous STEM experiences and influenced their future STEM-related career goals. Paul, Jason and Brianna said they want to be an engineer. Sabrina wasn't sure whether she wanted to be an engineer or an artist, while Christopher is debating between being an engineer or something in the "medical business." Annie wants to be either a vet or a marine biologist and Brandon a lawyer while Jonathan is going to be "a computer guy." Debbie stated she wants to be an astronomer, saying "I like stars and stuff." Fiona, Justin and Jacob said they want to be inventors when they grow up.

How might your inventing experiences be useful to you when you become an adult?

All of the kids agreed that the inventing experiences they are having will be useful to them into adulthood. Developing their problem-solving skills, presentation skills, and the invention process itself were mentioned as most useful by most interviewees. With this experience, Brandon, who wants to be a lawyer, discovered an interest in patent law. He explained, "Patent law is pretty interesting with patent infringement it's mostly contracts and stuff, and designs and stuff. If you don't have a proper design down, then someone may be able to modify it. We actually have to, on our log, draw our design, write our steps and have a witness sign it so that no one at the invention convention can steal our idea."

Do you plan to keep inventing things even if you don't win a competition or go to the Invention Convention?

An overwhelming 90% (53) of respondents answered "yes" to this question while 10% (6) answered "no." This is consistent with other responses that shows that these young innovators love the invention experience and that extrinsic rewards and incentives are not their motivation for their participation.

The final question asked these students to advise other potential young inventors.

If you could give advice to other kids who might want to invent things, what would it be?

It was clear from their responses that these young innovators were passionate about their inventing experiences. In an article on student motivation for learning, Crow (2009) describes a phenomenon she calls "point-of-passion," a student's first remembered experience that interested them in which they have since become engaged. Furthermore, these young innovators exhibited *harmonious* passion (Vallerand et al., 2003); i.e., one that results in a positive outcome, is in harmony with other aspects of their lives, and is integrated into their self-identification without conflicting with their other activities. They clearly see themselves as inventors and inventing as a positive activity, consistent with their interests. Hidi and McLaren (1990) found that this passion in childhood can persist into adulthood and even lifelong if supported by an adult (Crow, 2011).

Debbie suggested, "it would be to... have the most fun with invention convention is to choose a problem that you actually have, and not, like, other people would actually have, because when you actually have the problem you would be more interested and engaged in it than when, than if someone else has the problem." Fiona stated, "I would say, once you have your problem, try to think of as many different ways to solve it and then you could choose your best one."

Annie was passionate with her response, “Never give up. You really have to keep going with what you are doing. And you have to believe in yourself. You really have to believe. Um, you can’t say I can’t do it, or this is too hard, or there’s no solution, I can’t figure this out because you can. You just really have to think outside of the box, and you really have to believe in yourself. It’s like riding a bike, to say, you have to believe in yourself or else you’re never going to do it. To do this, you really have to believe in yourself and you also really have to think outside of the box. But nothing is going to happen if you don’t believe in yourself. So, you really have to believe, I’m putting that out there, but you really have to believe.” Jason had largely the same thing to say but in fewer words, “It would probably be, to never, if someone tells you that your invention isn’t going to work, and you still think it is, don’t give up on your ideas like I did at first. And then I went back to it, and it turned out to be a really good invention and it turned out to work well. And don’t give up on your ideas. “

Some of the boys were a bit more straightforward. Brandon suggested, “Find a simple problem, an everyday problem, and find a solution for it, a practical solution. It doesn’t have to be complicated. It can just be really simple” while Jonathan recommended “to have fun with it, and go for it. It’s a fun thing to do.” Jacob simply stated, “Probably, if you get stuck, like if you can’t do something, just find another way and keep going on your invention” while Paul said, “I would say don’t give up and keep your mind absolutely open, that you can do really anything and it’ll probably still come out really cool in the end. Christopher saw the invention convention as the end goal. He said, “Probably to do it, because there’s nothing bad that can come out of it. It’s usually just a good thing because, like, you might be able to get the opportunity, if it’s good enough, to go into invention convention.”

Brianna seems to be speaking from experience, “Don’t wait until the last minute. Try to find out what you are going to invent pretty soon. So, that way you are not waiting until the last minute and you don’t get rushed or anything. You have to work on it really hard, or it’s not going to work. You have to be really committed.” Sabrina stated that “since a lot of kids don’t end up with an invention in the end, I think they should know that even if their invention isn’t very good to them, to other people it might be one of the most useful things they’ve seen, they shouldn’t worry about how useful it is unless it has no purpose, they should just focus on getting it done and making sure it’s their best work.

A Case Study

Aaron is a young man in his early twenties. He is a graduate student at a mid-size university. He is also an entrepreneur.

Aaron grew up in an urban neighborhood (a “ghetto” by his own words), beset by poverty and crime, living in a small apartment with his mother and younger brother. As a young child, he would lie on the grassy area behind his apartment and look up at the sky, daydreaming about being successful and wanting to be someone who makes an impact on society.

Aaron’s mom did everything she could to nurture Aaron’s creativity. She would sketch little drawings on pieces of paper and leave them for him to find. She would paint figures and shapes on the covers of light switches in their apartment. She filled the apartment with pictures and artwork and unusual furniture pieces.

On weekends, Aaron’s mom would take her boys to all of the wonderful cultural and educational found in urban areas, such as museums and the aquarium. She would take them on walks into diverse and interesting neighborhoods around the city, venturing into boutiques and

past store fronts and large apartment complexes, some of which Aaron envisioned himself owning one day. He imagined the pride his mother would feel when her son became successful.

When it came time to get dressed for school, his mom dressed Aaron in colorful, patterned clothing and hats that some of the other kids thought odd and funny-looking. As he looked back on some of those outfits, he stated, “Those outfits that I had to wear helped me to become comfortable with being different and not affected by the words of others, words that could divert you off track, if you were not confident in your abilities and self. My foundation for being expressive, creative and internally driven was building at that point in my life. Those outfits that I had to wear helped me to become comfortable with being different and not affected by the words of others. Words that could divert you off track, if you were not confident in your abilities and self. My foundation for being expressive, creative and internally driven was building at that point in my life.”

Like the stories of many entrepreneurs, Aaron’s entrepreneurial spirit was demonstrated at an early age when he sold lemonade and ice tea at a stand he set up in front of his grandmother’s house, where he sometimes spent the summer. He found he really enjoyed selling things and communicating with his customer to make the sale.

In school, Aaron remembers fondly his elementary years. He excelled academically and really enjoyed and was interested in what he was learning. He attributes that to his teachers’ skills and personal interest in how he was doing. Then, things changed when he reached junior high school. He began to hang out with kids who didn’t share the same goals as he did. His teachers didn’t seem to be engaging or caring. His vision to be an entrepreneur became cloudy and less attainable.

When he got to high school, Aaron was almost at the point of giving up on his dream and heading for trouble. Then, he met Ms. Miller, a librarian who changed Aaron’s life.

Ms. Miller was different from the other teachers. She took a personal interest in Aaron, asking him about what he was learning and introducing him to new ideas and a variety of exciting resources. One day, Ms. Miller introduced Aaron to her son, Joseph, who was a senior at his school. She convinced him to go with Joseph to a special program for high school kids. The program’s mission was to provide educational and career programs that inspire young people from low-income communities to stay in school, to recognize business opportunities and plan for successful futures in college and careers.

This was exactly the motivational boost Aaron needed. He wanted more than anything to join this program but they had stringent requirements for membership and his grades had suffered during those difficult years between elementary and high school. Aaron worked hard and convinced the program leaders to accept him on academic probation. He spent every day working hard on his school work and then eagerly dedicated hours after every school day and all day Saturday in his other world, learning everything he could about how to be a successful entrepreneur. Mentors from corporate America talked with him about his business, invited him to their offices and even to their homes for holiday dinners.

Aaron learned to take some of the negative aspects of his neighborhood and use them to his advantage. His ability to communicate with a variety of people and constantly be aware of the dangers around him taught him to be highly sensitive to his surroundings and to be able to communicate with people from those who supported him from corporate American and charitable foundations, and his customers. He began to win awards and young entrepreneurship competitions. He was interviewed in local newspapers and magazines for his entrepreneurial activities. People recognized him as he rode the subway to school.

As his passion for entrepreneurship grew Aaron watched with a twinge of sadness as his friends drifted off and fell captive to the downward spiral that plagued his community. But he smiles as he remembers the two women in his life who inspired and supported him---his mother and his librarian.

Conclusions & Recommendations

The results of this pilot research study with 67 young innovators in grades 4-8, who participated in an online survey and telephone interviews based on the five research questions, have implications for school and youth services librarians.

Research Question #1: In what ways does participation in innovation activities affect student motivation?

- Intrinsic motivation is more likely to occur when a person finds the task engaging, autonomous, and feel they are competent in the area. Many children indicated that they were not upset at not winning a prize, but were thrilled with the opportunity of making it to such a prestigious competition and being able to share with others.
- Children typically have an intrinsic motivation to innovate/create, often with an altruistic perspective.

Research Question #2: What information resources and technologies facilitate students' innovation process?

Research Question #3: What information skills are most important for young innovators?

- Websites were the most heavily used resource according to participants.
- Many participants' inquiry activities centered on whether their ideas already existed but most had limited knowledge of how to search the Web to find this information.
- Many used faulty methods to assess the quality of the resources they found.
- Parents were the most used human resource; librarians were the least used human resource.

Research Question #4: What roles do teachers and librarians play in supporting and facilitating student innovation?

- Several participants felt that their teacher could have helped by providing more information on the invention process.
- Most viewed the library as a book repository and librarians as guides to the books in the collection.

Research Question #5: Is there a relationship between participation in innovation activities and interest in STEM learning?

- Many students who participated in innovation activities as children indicated an interest in future STEM-related careers.

Librarians can transform their libraries into innovation spaces by stimulating students' creative inquiry and innovative thinking. Below are a few examples of ways to do that.

- Teach critical inquiry skills just at the time they are needed and in the context of the innovation process.
- Tie these skills and activities with relevant curriculum and standards to help reinforce their importance and relevance.
- Provide students with pathfinders for important, relevant print and electronic resources to get them started once they have an idea.
- Keep options for exploration open and varied as the school library is one of the few areas with open scheduling to allow for such freedom and autonomy.
- Teach students brainstorming and other innovative thinking techniques.
- Show students how to work backwards from an existing problem to a potential solution, rather than just trying to invent something new.
- Encourage students to adjust and test their ideas throughout the process.

A full-scale study, based on the pilot study but expanded to include a larger potential participant pool, will be conducted in 2013.

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APPENDIX

Young Innovators' Descriptions of Their Inventions

- The invention I created is a pair of socks with fluffy balls on them. The number of balls on the sock allows the user to determine the color of the socks (1 ball equals blue, 2 balls equal brown, ETC.). The balls could also be used to hold the socks together in the wash, because the balls are attached to the sock with a loop, and the balls of the other sock can fit into that hole and become secure.
- The invention I created was a tool that can take off a tick with even touching it. After it could be sent to a doctor for testing. It's a little hard to explain but if you email me at ituneskeb@gmail.com I can send you pictures and links.
- backpack raincoat, herb dryer, cardboard things with cat litter glued on to help get cars out of snowbanks.
- My invention is a small device that you can put on the top of the laptop display screen. This invention can cause less neck pain because instead of on the side it is on the top of the laptop.
- i have been picked to go to Invention Convention twice. The first invention was called 'The Gaming Station'. The purpose of this is to hold the IPod when you are gaming so you don't have to hold it in your hand. The second invention was called 'Tilt-A-Baby'. It is an attachment for an umbrella stroller to hold the child's head back when the child falls asleep and their head doesn't fall over onto its lap. I ribboned at the convention for both of these inventions.
- I invented a shoe that you can use as both a wedge and a high heel. I made this possible by creating a cork wedge I can slide onto the heel that will stay in place and make a convertible shoe.
- I created an invention called The Stylish Kam Pod Kit! i created this invention because people who are in a rush and dont have time to grab their purse. So i invented this because i sticks right on to your phone and you can put in things like...money, gum, credit cards, and much much more.
- Wind-O-Matic 1) Airfoil on top of model car to give lift - reducing car weight -saving energy. 2) wind powered - from forward motion - generator to recharge batteries in electric cars.
- The invention I created is called the pocket chiller it is a device that fits in your pocket and holds medications, candy, etc. and keeps it cold for up to six hours. Just put it in your freezer open before you go to bed and it is ready for use whenever you need it. Fast, easy, and compact.
- The invention i created was the lobsterpot light. it was a garden light that we changed from a white bulb to a amber one and glued it to a lobster pot. so it would not waste energy we got a light with a solar panel and a sensor so it would only turn on when it was dark.
- The Heated Horse Saddle uses activated hand warmers velcroed inside cloth mounted to the saddle.
- Task Bracelet: It's a bracelet that people can record down what they want to remember without writing on their hands or arms.
- Snow-Be-gone, an invention to melt snow and ice buildup on the sides of windshields.
- It was a Garbage mobil AKA the Garborator AMO 802 GC

- I created the Sewer Stopper. It covers the sewer so balls, pucks, trash, and other objects don't go down into the sewer.
- I created the wear and dry. what it does is, if you ever get wet pant legs, you can step into the two holes at the bottom and it will dry the pant leg or shoes.
- a book stand that makes it so you wont hurt you neck when you read
- The compost dumper makes it easie to delive your compost to the bin.
- My invention is a portable solar powered electrical outlet. You can plug anything into it and it will give you energy instantly. It is solar powered and can be charged to use anywhere. My invention is almost like a mini generator that is "greener" (solar powered).
- I invented a band aid and a ice pack put together
- A locker organizer to keep your locker from getting crowded and makes it easier to find your books
- I created the Phone Bungee. It connects to your phone on one end and on the other end it connects to your pocket. The use is so you don't drop your phone, camera, ipod, etc. while on a chair lift or boat.
- I created a attachment that goes on your backpack to make it more comfortable. I made a second attachment that was for when you were walking it vibrates and is very relaxing.
- My invention is a protective military mask. It prevents any bullets or fragments from the skin. It also keeps you cool in the desert and hot in the cold. This also can hold radios or can fit on a helmet. It does include goggles because they already invented bullet proof goggles. This mask is better than any other mask because it fits the soldiers' needs.
- the invention I created was something you would attach on a dog leash to hold your dog walking necessities such as cellphone, dog treats, poopbags,tennis ball in removable ball holder, you can also clip on a "chuck it " ball thrower and, reflective tape for walking at night
- I invented the Fruity Finish a product designed to enhance the ways of cutting apples. My invention is a clay cutting board designed especially for apples to easily wedge into slices. This way it is without the hassle or risk of knives and wedgers on regular cutting boards.
- I created the Handy Harness, a harness that attaches to you and a dog. Your hands will be free and the tugging will have less force. I created the handy harness by using snowpant belts, clips, and a workout belt (I don't count the sewing supplies or the leash because the leash is not really part of the invention.
- My invention was a outside air bag system for a car. It has airbags on the outside to protect the toy car.
- My invention was the "Ouchh Gone" It was made out of Cushion and Colorful Cotton Balls. It is designed to be put on the corners or edges of any type of furniture and/or doors.
- I invented an umbrella that is supposed to make your day relaxing. It comes witha homemade cup holder that uses homemade insulation to keep your drink cold. On it there is also a cap that you put on your drink that is attached to the cup holder so that bugs don't get in your drink but you can still use a straw. All of this is attached to the umbrella. there is an ipod speaker on the side of the umbrella that sits underneath the umbrella so that the i pod can sit in a compartment made for the ipod. There are multi colored lights under the umbrella and an adjustable that you can move towards or away from you.

- I created a paint that smells more delightful than the average wet paint smell. It is not harmful to breathe in, therefore preventing parents to worry that the fumes will disturb their children and harm their pets
- I invented the R.Y.H (remember your homework) bracelet. It helps you to remember your homework without using an agenda. It will help you get good grades on your homework.
- My invention was called The High Up Helper. It was made as a nightstand for the top bunk of a bunk bed. Since most nightstands can't reach all the way to the top The High Up Helper hooks onto the side of the bed.
- My invention is called the Ice Elevator. It helps when you get surgery on a joint. You will need a bucket that must be filled with ice water. There is also a special ice pack that must be filled with that ice water to cool the hurt joint. Then there is a tube that connects from the bucket to the ice pack. The bucket must be raised so the water flows in to the pack. Then when the water is warm the bucket must be put down so the warm water drains out. My invention is made by PVC tubes, rope and nails, plus a hand made wheight made of sand, tape and a stocking. My invention brings the bucket up and down when needed by using only your hands. pulling down makes the bucket go up. pushing up makes the bucket go down.
- I created a device that in the winter warms your shoes.
- My invention is a small clay model that would represent a remote control that would help people with Trecher Collins Syndrome. People with Trecher Collins Syndrome are born without ears, but have a hearing aid surgically implanted where their ear would be. The remote would have 2 buttons. One that would allow them to hear in broadband, which is when they can hear everything. And one button for singleband, which is when they can hear only one specific noise. And there is a dial to turn the volume up and down. There's also a keychain attached to make it easily portable.
- I created a special drink holder that prevents your drink from being knocked over. A suction cup is screwed onto a cup holder. To use my invention, you push down on the suction cup until the red line disappears and place your drink in the holder.
- "Mail Alert " It is a flag for wall mounted mailboxes to indicate outgoing mail.
- The maiLight is a mailbox that has a light in it. In order to not waste the battery, the light only turns on when the door is open because of a refrigerator-type push button.
- It is a mind movie projector. It takes your thoughts and projects them onto a wall or screen or any flat surface.It is worn as a headband and takes the different signals of your brain and puts the together into a picture.
- I created a counterweight adornment for necklaces that attaches to the the necklace clasp.
- Turbines in house pipes use moving water to create electricity which powers small devices or stores the electricity in battery form.
- S.H.I.M. (Steering Wheel Heart Intergrated Monitor) Using electrically conductive material the S.H.I.M. will measure your heart beat and transmit it to a monitor. When your heart beat fluctuates a warning will warn the driver of a irregular heart rate. If the driver is feeling well and is still conscious then a button will be to ignore the warning for false alarm reasons. If a driver does press the button and the heart rate continues to drop or raise a GPS locator will alert the nearest public safety station. Also,if the driver does not press the button the same process will occur.
- My invention was a plastic wrap that went over signs to stop vandalism. First it would be put on a not vandalized sign with a very strong sticky glue. This would hold it on the

sign. Next after it has been vandalized the town would come peel it off, and replace the wrap. If this was sold for \$5 each, and made at \$1 each the profit would be \$4 each wrap sold.

- I have created edible cupcake wrappers. They are an edible liner that the cupcake is baked inside of; you can just eat the whole thing, rather than unwrapping a liner and then indulging. It is made from edible wafer paper. This is convenient, and environmentally friendly.
- I have created an invention that helps handicapped men and women get their mail from the mailbox without having to leave their house. It works with a pulley system that carries a tube to and from the mailbox to your house.
- Katz Matz are designed to protect the back and front of your shirt and pants from getting soggy and dirty when riding a bicycle on wet and muddy terrain. Katz Matz are made using bulk mats that are secured by strapping and parachute and connecting buckles. Reflective ribbon is affixed around the edges of the front, back, and reverse side of the mats as an added feature.
- I created a reinforced binder made with particle board, sheet metal, duct tape, and a three ring system. I put it through numerous tests such as dropping it 50 times, pulling it from my backpack 50 times, and opening the ring system 50 times. After these tests it showed no sign of weakness.
- The problem my invention solves is chickens getting frostbite.
- I created the pet food light alert which alerts my brothers and I when our chickens are low on food. It is designed off of a spring scale because you hang our chicken feeder on two screwed together springs which have a paperclip wound around the bottom of both springs and stuck up through the middle of a spring and hits a limit switch which is attached above the feeder. When the limit switch is pressed it turns an led light on that is part of the circuit. Then the light shines through the coop window and we are alerted in the house that our chickens are almost out of food by looking out the window at our coop.
- My invention is a ordinary lobster with a solar panel modeled after old buoys which are balanced with a stick, also making the light easy to see. The ordinary solar lawn light is fashioned into the buoy.
- I invented a kit that included items that would help people relax.
- The invention I created is called "The Jacket Butler". It is a simple dressing aid that helps those with arthritis and limited range of motion in there upper bodies, to put on their jakets, coats, or cardigan sweaters. It consists of a telescopic magnet and a magnetic clip.
- It's a "Fire Hidter", a decorated vase with flowers that goes over a kitchen fire extinguisher. I also invented a "do it yourself" kit so that kids can make this at home. They can decorate it with the colors of their choice and put flowers in to match the colors of their kitchen at home.
- The invention I made was a rake that would slide into itself, and it's head would fold for easy storage.
- I made a sock pairing organizer. It makes that chore of pairing up sox last shorter.
- The Pocket Chiller is a device that allows people with diabetes or any other disease able to keep there insulin or other medications and snacks cold inside a device that fits in there pocket and lasts up to 6 hours.

- I created an invention that clears snow and moss off your roof by use of ethylene glycol dripping through a drip system. I later switched it to propylene glycol because ethylene glycol was toxic to the environment.
- I invented the "Easy Fill Gas Tank." It is a car with the gas cap on both sides of the car.
- A litter box that has a sifter the size of the box. That makes it much easier.
- My invention was the Aqua Ball, a giant hamster ball for people for traversing across lakes.
- The invention I created is an easy portable device that folds and unfolds. It solves backpacks not being on the ground.

Adapted Version of Intrinsic Motivation Inventory

Response Choices:

Not at all true

Usually not true

Sometimes true

Usually true

Very true

Items:

I enjoy inventing things very much.

I created an invention because I wanted to.

Inventing was fun to do.

I often feel worried when I am inventing.

It was important to me to do well at inventing.

The invention activities were interesting and enjoyable.

I would describe inventing as fun.

I think I am pretty good at inventing.

I felt like it was not my own choice to create an invention.

I made my own decisions about what to invent.

I am satisfied with how I invent things.

The more difficult the problem, the more I enjoy trying to solve it.

Inventing is boring.

I put a lot of effort into inventing.

It was my choice to participate in the invention program.

After working at creating my invention for a while, I felt pretty capable of being successful.

I feel confident in my ability to create an invention.

I didn't try very hard to do well at inventing.

I think inventing was an important activity for me.

I did not feel nervous at all about participating in the invention program.

I would like to participate in future invention programs because I enjoyed my experience.

Responses to Final Survey Question---Optional Comments

- I have won 2 rewards at the invention convention
- It was an interesting experience and I would recommend to others.
- I love inventing. I am always thinking of ideas on how things could work better.
- Yes, they should've informed us our invention had to be environmental to win a large award.
- I think this whole experience was awesome because i got to meet new people. And have the best time making the invention. i am also thankful for the pettit fondation for helping us to put this all together. and it was cool to see all the great inventions.
- It was awesome and i won an award at the state wide convention
- i loved it and will be doing it again.
- It was fun building it!
- I love being creative when I invent and I want to keep inventing because I love to do it.
- It was a very fun experience and i am glad i got to be a part of it. It was an amazing experience.
- It was very fun also looking at other peoples inventions to.
- I had a great experience but thought it would be really cool if there were more categories
- Because I don't think my invention was that good, I want to keep inventing!
- It was amazing to go to see the actual campus of uconn, and i hope to get in there for collage because they have a amazing engineering program there for me because i hope to do engineering for my futer job.
- I love inventing things that will help people in many ways. This experience was a very good one. I loved the challenges in inventing and sharing my thoughts to people. I will never forget this wonderful experience.
- I LOVE IT SOOOO MUCH! IT IS SO MUCH FUN! I DONT EVER WANT TO STOP!!! : D
- If it weren't for S.T.E.P. (student enrichment program) at Yalesville Elementary I wouldn't have invented anything. My S.T.E.P. teacher especially , Ryan's full time nurse (he has a trach), his mother, and his doctors at NECHEAR (New England Center Hearing Rehabilitation) helped me and answered many of my questions. Without these people I wouldn't have been able to make it this far to answer your questions. During my inventing experience I went with Ryan and his family to one his checkups at NECHEAR. There I spoke with his doctors and learned a lot more about his BAHA implant. After that fun and interesting visit all my questions about the implant were answered. I also really understood all the challenges Ryan has to face. I hope others will also understand and try to help.
- It was also a learning experience
- I enjoyed going to UCONN very much but, I was a little nervous!!!!
- I was nervous presenting to the judges in school and at the UCONN convention, but all the judges were nice, and once I started, it wasn't hard at all.
- If I am not inventing something I am trying to improve other objects like the car or stuff for the fire department.

- This year was my first ever Invention Convention and I won a Recognized Inventor award. Also, I got to present at my schools Board of Education meeting and everyone asked for me to make them one and told me I should market it.
- I think I had a very good idea yet no one recognized my great idea as a life saving tool.
- I am a two year invention convention veteran and this year i didn't get reconized but I'm going to keep working. I still have a journal full of ideas ready to be used
- I think the lower seating level should be reserved to the inventors only for the awards ceremony.
- I love inventing different ways to solve problems.
- none
- I enjoy inventing every year because of the values that could be useful in life that I gain and because it is very fun and informational.
- It was interesting when things went wrong to figure out how to revise my invention
- The main reason why I love and do inventing is because it is challenging, which makes inventing fun.
- I had so much fun at the Invention convention, my sister and I plan to go back next year on our own (my school only does it in 5th grade). I don't know what I'm going to invent yet, but I have lots of ideas.
- I think it helps kids stay very creative.
- The inventing experience is the best. It just gives us a chance to express ourselves
- I found the competition very exciting and enjoyable it allowed my to be very creative and use all my inventing knowledge it was a exhilarating experience for me and my family and in the end my work paid of as i one an award.
- Is drawing a new cartoon character to invent a 2 minute animation video considered inventing? If it is, I made some really good ones while I was making my invention for the invention convention.