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The Post-Disaster Survival Scenario as Context for Science Education

Abstract

The theme of survival in a post-apocalyptic or post-disaster scenario as context for science education is explored in this article. Though this theme is prevalent in a wide variety of popular media, only a small number of educators and researchers report having explored it as a means of engaging students, and there is almost no description of its use in teaching science in the pertinent literature. We demonstrate, by illustrating commonalities between this approach and other successful methods, and through the results of classroom evaluations we have obtained, that there is good reason to suggest this theme would succeed as a tool for teaching science at elementary, secondary and post-secondary levels.

Introduction

One of the most familiar hypothetical scenarios we use in entertainment and conversation is based on questions such as, "what would you bring to a desert island?" or "if society were to collapse tomorrow, what would you do first?" Scenarios like these are not plausible enough to be frightening, but are still based on the possible or the historical, and are engaging to a wide audience as a result. Fantasies based around disastrous near-future scenarios have always been popular, and stories of survival without the amenities of modern development continue to be prevalent today. Themes such as survival on a desert island (*e.g.* Robinson Crusoe, 1719) have been replaced with more timely stories such as surviving in the wilderness (e.g., *The Lord of the Flies*, 1954; *Lost in the Barrens*, 1956; *The Hatchet*, 1987; *The Edge*, 1997; *Lost*, 2004). Additional to these situations pitting individuals' skills against the environment (and in many cases, each other), many popular stories since the early 1800's have focused on a near-future scenario where disaster has placed humankind back into a survival-situation. One can also observe a surge of recent television shows and movies (e.g., *The Walking Dead, Revolution, I Am Legend, The Road, The Hunger Games*) involving this type of setting or situation, the popularity of which suggests that students are familiar with this type of story. In all forms of popular media one can see a resurgence of this theme over the last five years. There are several possible reasons for this, ranging from the Mayan calendar ending in 2012 to ubiquitous news stories about our collapsing environment to increasingly erratic and damaging weather. Now more than ever before, this possible scenario is at the forefront of popular awareness.

Keywords: survival, science, disaster scenario, emergency preparedness, inquiry-based teaching

While sensationalizing the idea of surviving a disaster is becoming more common subject material for entertainment, education devoted to disaster preparedness has not enjoyed the same resurgence of interest. Programs of education focused on preparing youth for unexpected situations by developing knowledge of basic survival skills have been widespread in North America and Europe since the early 1900's (perhaps the most well-known of these is the Scouting movement), but a focus on practical application of these basic skills has gradually diminished from public education curricula.

In this article, we argue that employing the post-apocalypse or post-disaster scenario as a theme for science education is straightforward, timely and can generally be expected to succeed in increasing student engagement and achievement of learning goals. We draw attention to examples of educators who have succeeded in using this theme to better achieve learning objectives in other disciplines, and demonstrate that there is ample reason to expect similar or greater success in applying this theme to the science class. We show commonalities between this idea and other pedagogical approaches generally accepted as successful, and in doing so argue that the post-disaster theme should be similarly successful and can integrate seamlessly with these approaches. We present the results of classroom and community outreach experiences in which this theme was employed and from which the success of this approach can be assessed. Finally, we present some specific examples of how this theme can be integrated into the curriculum.

Educators Already Employing this Approach

One would expect that many educators are taking advantage of the popularity of the survival theme and are crafting their lessons and activities around scenarios like this. It is surprising, then, that so few accounts of this type of work may be found in published literature, and almost none relating to its use in the science classroom. One can find evidence of its use in history courses (Schaub, 2006), and in more specific subjects such as contagion outbreak preparedness education (Rucker, 2005). In some districts, practical instruction in survival skills is still a formal part of physical education instruction, but there are only a few published accounts of educators (e.g., Chaniotis and Delany, 2010; National Aeronautics and Space Administration (NASA), 2006) drawing connections between the skills necessary for surviving a disaster and the scientific concepts underpinning these skills.

A science educator who has participated in a Scouting program, enjoys camping, has experienced a disaster situation or is otherwise familiar with the skills included in survivalist training will, upon reflection, recognize the opportunity to make meaningful connections between the subject matter of any science lesson and survival skills. We assume that, while published accounts of the results of this approach are rare, it is actually being undertaken in many classrooms, and this report may prompt others to contribute analyses of similar experiences to the literature.

The Potential for Success of this Approach

In support of the argument that one can expect this theme to be generally successful in science classes for students of different age levels, we present two separate but complementary pieces of evidence: first, we show commonalities between the use of this theme and the implementation of problem-based or inquiry-based pedagogical approaches that are generally accepted as successful, arguing both that the survival theme is likely to succeed for the same reasons and also that it can be seamlessly integrated within these instructional frameworks. Second, we present the results of two types of classroom experiences where this approach was employed. The results of evaluations conducted for program improvement were obtained and lend further support to the suggestion that this theme is generally successful at improving achievement of learning outcomes.

Commonalities with other Pedagogical Approaches

Though there exist many different interpretations of the constructivist approach, most definitions involve altering the focus of teaching by putting emphasis on the students' ability to construct their own knowledge (Prawat, 1992 as cited in Applefield, Huber & Moallem, 1990). While the idea of using a post-disaster or post-apocalypse survival scenario is not, in and of itself, necessarily a constructivist approach to teaching (Brooks, 1990), it naturally includes elements that are requirements for successful implementation of a constructivist approach.

Basic tenets of the constructivist approach are learning content through context, and enhancing the potential for student success in the classroom through relating to application, real-life examples and hands-on learning (Devitt, 2011; Scott, 2013; Ergul, Simsekli, Calis, Ozdilek, Gocmencelebi, & Sanli, 2011; Velooa, Perumalb, & Vikneswary, 2013). Through the opportunity to interact, reflect, and gain feedback on these relatable problems, students further develop their critical thinking and reasoning skills (Masek & Yamin, 2011). Though originally developed for use with medical students (Barrows & Tamblyn, 1980), Problem-based Learning (PBL) has enjoyed varying success in many disciplines at the university/college level (Sheridan & Kelly, 2012), as well as with small children (Zhang et al., 2011) and secondary school aged students (Jerzembek & Murphy, 2013). PBL (Marx, Blumenfeld & Soloway, 1997) involves projects that are central to the curriculum (as opposed to perfunctory subjects such as an attention-getting discrepant event that cannot easily be connected to the main theme of the unit) and are realistic. Though students are probably no more likely to have first-hand experience with trying to start their own fire or in other aspects of wilderness survival than they might have had twenty years ago, popular television programs like "Doomsday Preppers" or "Seconds from Disaster" have made this a relatable topic for today's student. As constructivism is, essentially, a process of learning that proposes students generate their own meaning and understanding by combining previous knowledge and new experiences (Richardson, 1997), a topic like disaster survival, which is a familiar subject in popular media and lends itself to hands-on and engaging instruction can provide many opportunities for the employment of this approach .

Scientific Inquiry (SI) and Problem-Based Science (PBS) can be viewed as sub-categories of PBL, and are more specific in that the term "inquiry" is

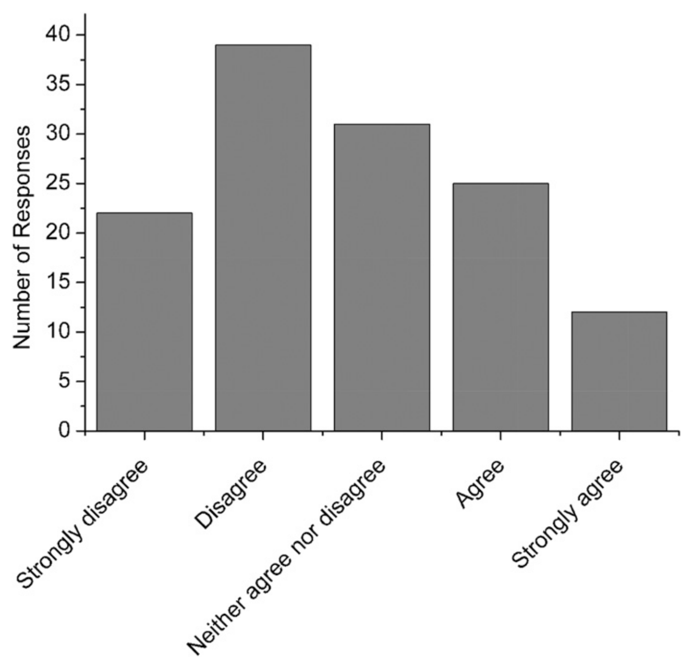

Figure 1. Cumulative 129 responses to Questions 1, 2 and 5 in the survey shown in Appendix A, which pertain to the clarity of a topic that was addressed using a survival scenario at one point in the class. Responses to Questions 1 and 5 are reversed (*eg.* "strongly disagree" is changed to "strongly agree") and added to the responses to Question 2, so that all data shown similarly associates stronger agreement with more positive opinions of the survival-themed lessons

often used to imply approaches to learning drawn from constructivist pedagogy The ideas behind inquiry (e.g., formulating scientifically oriented questions, generating evidence and explanations for the evidence (National Research Council [NRC], 2000) overlap with the elements of PBS (e.g., examining a driving question, formulating hypotheses, investigating the question, analyzing and communicating results [Marx, Blumenfeld and Soloway, 1997]). Literature around both "inquiry" and "problem based learning" (Hmelo-Silver, 2004) emphasize the importance of using real-world problems to engage students and to activate prior knowledge to facilitate the processing of new information.

The use of the survival scenario as a context for learning science concepts fits within both a traditional PBL approach and a PBS approach. Following the PBL approach, students would be presented with a complex survival scenario whereby they would proceed through the PBL learning cycle (Hmelo-Silver, 2004) to solve it. Following the PBS approach, students would be presented with one or several driving question(s) that would allow them to collaboratively investigate the answers to these questions by designing "inquiry" experiments that would generate data (evidence) and allow for explanations of this evidence.

A learner's motivation, engagement, attitude and level of interest in a subject or lesson play a crucial role in their learning and level of achievement. According to Pintrich (2003), researchers interested in questions about how and why some students thrive in school contexts while others struggle must consider the role of motivation. In a study by Chang and Mao (1998), students exposed to inquiry had significantly better attitudes toward science. These students preferred taking an active role and responsibility in their learning that resulted in higher overall achievement levels. Other studies found similar results, demonstrating that students who were exposed to an inquiry approach had improved attitudes towards science and school in general. These studies also showed negative attitudes resulting from traditional methods (Gibson & Chase, 2002; Selim & Shrigley, 1983). Educators, as well as students, benefit from this approach—teachers find an inquiry-based classroom more engaging because of improvement in students' attitudes and engagement in the learning process.

As mentioned above, there are few published examples to draw on that report on how using the survival scenario affects motivation and engagement. Chaniotis and Delaney (2010) demonstrate that the use of a "desert island" survival theme for teaching science concepts lead to greater engagement in young students, and the results we report below support this finding.

Besides including specific, sought-after ingredients such as engaging, relatable topics and problems that are non-school-like and that require hands-on problem solving, the survival scenario can enable an educator to achieve goals *beyond* those promised by general approaches such as PBL or PBS. The use of the survival scenario has all the qualities necessary to be an effective critical thinking topic, but it is especially powerful in demonstrating the practical significance of scientific skills and quantitative reasoning. The contextualized scenarios are not simply a "hook" to engage students in boring or unrelated content that may follow; lessons built around survival scenarios can illustrate how inquiry can quantify the level of risk, explain the nature of these problems and ultimately provide solutions. When today's students are faced with the seemingly overwhelming list of social and environmental problems that threaten the continued success of civilization, they can be left feeling powerless and uninspired to make any improvement. What can be achieved through this approach to teaching science has much in common with the original goals of programs of practical instruction such as the Scouting programs. Development of real-world solutions and consequences enhances motivation in learners and instills a sense of empowerment that is difficult to achieve otherwise (Hoffman & Ritchie, 1997; Hmelo-Silver, 2004).

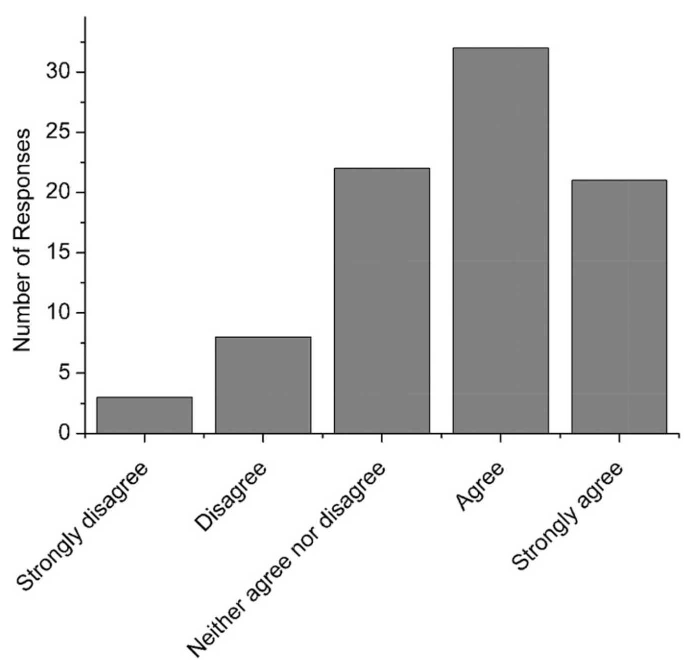

Figure 2. Responses of 43 students to Questions 1 and 5 (for a total of 86 responses) of the survey shown in Appendix A, which both asked students to agree with a statement related to whether the treatment of topics using a traditional method that involved hands-on activities was clearer than when the same topic was addressed using the survival scenario with discussion or demonstration

Responses to this Approach in the Science Classroom

Assessment of two different types of classroom experiences in which the survival scenario was employed as a vehicle for science concepts are described. In one, a first-year undergraduate science class for students preparing to be teachers of kindergarten to grade six was provided six lectures addressing elementary school science unit topics and which included some content delivered within the context of surviving a disaster. At the end of the semester, the class was presented with a survey to evaluate the usefulness of this approach, and the results are tabulated below. In the second, secondary school classes were invited to an "Inquiry Day" at a University, during which they were exposed to selected scientific concepts through a mini-lecture and hands-on activity addressing disaster survival skills. The results of two years' worth of student responses to a questionnaire distributed by University recruitment officials have been analyzed and interpreted in terms of student responses to this aspect of the day's activities.

First-year, pre-professional education students. The undergraduate class in which the survival theme was employed was aimed at instruction in elementary school science, and historically most enrollment has been by students who did not feel confident in their level of competence in science or mathematics. As such, student engagement was of particular importance in successful achievement of learning outcomes. Key topics in the class were addressed more than once throughout the course, and in some cases a topic was taught using the survival theme and at another time the same topic was addressed using an alternative (sometimes more traditional) method. For example, during a lesson on friction the class was introduced to the critical requirements of making fire during one class, and in another session was also instructed in how a conventional physics approach to friction (using a free body diagram and breaking forces into components) can be used to explain how friction can be calculated. As another example, the topic of structures and stability was addressed in one class by guiding students through the creation of makeshift shelters using tarps, ropes and sticks, and in another class they were exposed to the same concepts as they attempted to construct structures using clay and toothpicks at their desks. In this way, every time the survival scenario was used there was an alternate format for addressing the same material with which it could be compared.

As a means of program improvement, an anonymous student survey (included in Appendix A) was distributed to the class near the end of the semester, using five-point, Likert-scale questions aimed at evaluating the effectiveness of this approach in three areas: student engagement, clarity of content and the extent to which students retained the information. Forty-three students from the class participated in the survey and the results are shown in Figures 1 to 4.

The results of this study are subject to several limitations and confounds that impact the interpretation of the data. Because the content of the classes was not designed to specifically evaluate the effectiveness of the survival scenario, the student responses are not completely unambiguous and interpretation of these results is subject to some unquantifiable uncertainty. Student responses may have varied as a function of the amount of time that had passed since a particular session and the administration of the survey (which varied from one day to four months). Additionally, the enthusiasm and general approach of the instructor during different sessions cannot be assumed to be consistent throughout all classes. Finally, because a particular session may have involved both a "hands on" approach and the use of the survival theme, it is not possible to completely de-convolute the effect of one approach on student response from that of another. Even with these limitations in mind, however, the survey responses provide some insight into the effect of the different approaches on the student experience.

Figures 1 to 4 show the data obtained from the surveys, recast in an attempt to show the dependence of student experience on the use of the survival

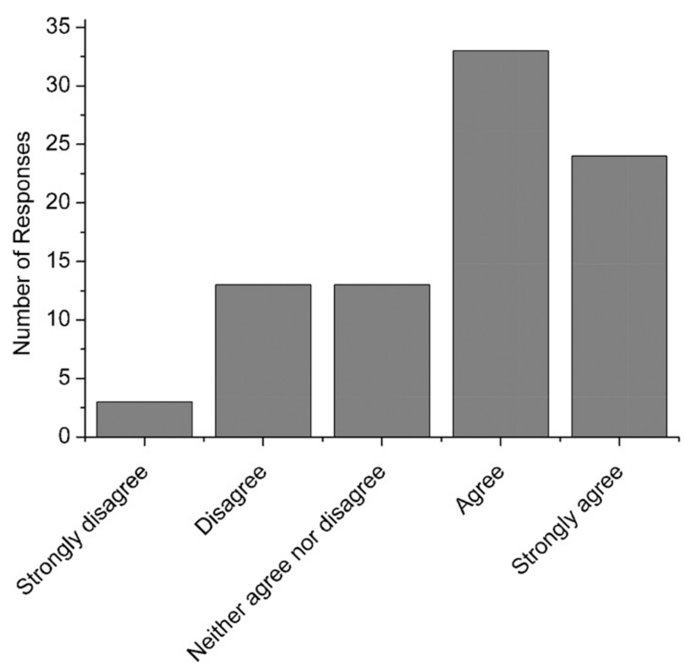

Figure 3. Responses of 43 students to Questions 3 and 6 (for a total of 86 responses) of the Survey shown in Appendix A, which both test agreement with statements that material addressed through a survival scenario was more engaging than when addressed through a more traditional method

theme and on whether the content was delivered through a hands-on, lecture-style or demonstration-style approach. For some of the survey questions, a response of "5" on the Likert scale indicated the most positive response (in terms of the use of the Survival theme), while for others it indicated the least positive response, so that comparison of the response to questions involved reversing this order. For example, Figure 1 indicates that use of the survival method did not, on its own, improve the students' opinions of the clarity of a lesson. Responses from 43 students to Question 2 (in which students are asked to agree or disagree with the statement suggesting that a survival-themed demonstration was clearer than a traditional lecture approach) are added to the *reversed* responses from the same 43 students to Questions 1 and 5 (in which students are asked to agree or disagree with the statement that a traditional approach is clearer than a survival-themed approach), for a total of 129 responses. In this way, responses of "Strongly Disagree" to Question 1 and 5 are counted as "Strongly Agree" in Figure 1, where all data shows stronger agreement associated with more positive opinion of the survival-based lesson. Each of the three questions focus on the clarity of the lesson, but the effect of using the survival theme is confounded by the effect of different presentation methods. In Figure 2, two thirds of the data shown in Figure 1 are recast to illustrate the effect of whether the lesson incorporated a hands-on element or not. The same responses of the 43 students to Questions 1 and 5 (without reversing them) are added together, such that stronger agreement reflects an opinion that the hands-on approach (which was not combined with the survival theme in the sessions referred to by these questions) was clearer. The data shown in Figure 2 suggests that involving a hands-on element is much more likely to improve students' perception of clarity than using a theme like a post-disaster survival scenario.

In Figure 3, the response of the same 43 students to survey Questions 3 and 6 (for a total of 86 responses) are shown. Both questions pertain to how engaging students found the lesson, and the data shown in Figure 3 demonstrates that the survival theme was found to be much more engaging than a more traditional approach (when the mode of instruction is otherwise the same).

In Figure 4, the reversed responses of the students to Question 4 are combined with the responses to Question 7 (for a

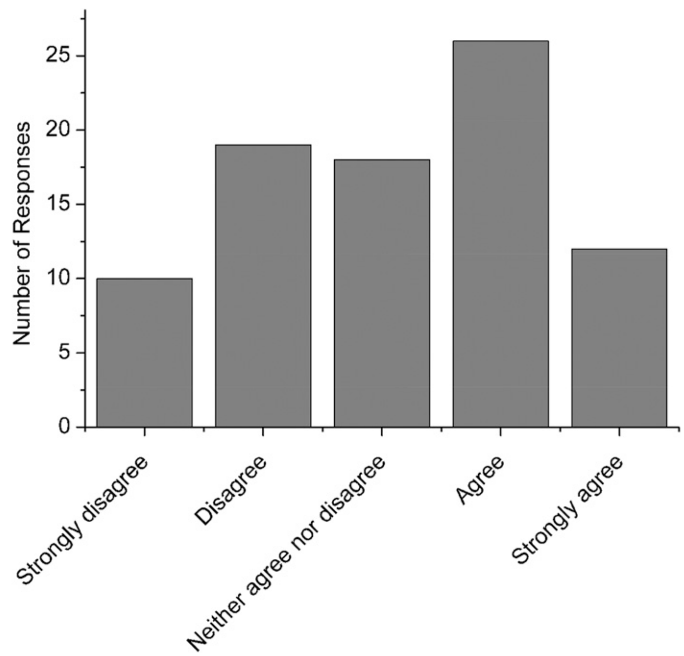

Figure 4. Responses of 43 students to Questions 4, with agreement reversed, added to the responses of the same 43 students to Question 7 (for a total of 86 responses) of the Survey shown in Appendix A, such that agreement in all responses is with the statement that the lessons addressed using a survival theme were easier to remember than those that did not involve the use of this theme

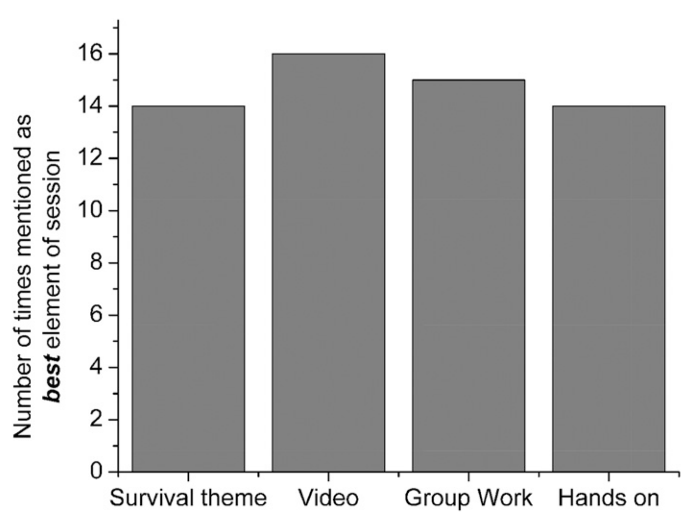

Figure 5. Survey responses from 70 secondary school students collected after their participation in a multi-disciplinary, survival-themed inquiry session. The number of responses to the question "what did you enjoy most about the inquiry session?" explicitly mentioning the four most popular answers are shown

total of 86 responses), so that stronger agreement is associated with students finding that the lessons incorporating the survival theme were easier to remember than those delivered without the theme.

The results of this brief analysis may be summarized as follows: the students reacted favorably to the survival theme and found it engaging, but given the choice between a hands-on lesson based on a traditional problem and a discussion or demonstration based on a survival theme, these students found subject matter was more clearly presented using a hands-on approach. Of course, the survival scenario theme lends itself especially well to hands-on activities, as the materials required are necessarily minimal (due to the nature of the scenario, exotic, expensive or cumbersome materials are never used in survival strategies) so there is no reason why a science teacher need choose between one approach and the other.

High School Inquiry Days. Seventy secondary school students and five teachers/councilors visited a University campus during their spring break and participated in an introduction to University Inquiry Day, arranged by the Office of Recruitment. As a means of comparing and contrasting the approaches to problems taken by different disciplines, students were guided through a scientific mini-lecture and a hands-on activity, followed by a social studies-based activity. The latter two activities were conducted in small groups of 4-5 students. The entire session focused on surviving a disaster, and the science lecture component addressed the concepts underpinning skills such as making a fire and purifying water, and included a video presentation, demonstration of making fire by rubbing two sticks together and polishing a soda can to create a parabolic reflector. Following the lecture, students were broken into small groups and completed an activity in which they designed and built their own water filter out of a discarded water bottle (following a popular lesson published by Engineers Without Borders, 2004). The final element of the session involved them working in small groups to plan out a social/political response to finding themselves in the post-disaster scenario.

As was the case with the first year pre-professional year science class, the anonymous evaluations were collected for the purposes of program improvement before this research project was initiated, and obtained for analysis long after the classroom activities had ended. The survey questions were not specifically aimed at assessing the effectiveness of the survival theme or any other specific aspect of the sessions. As one might expect, the response of students was overwhelmingly positive when asked questions like "did you enjoy the session?" and "would you attend another session?", but the effectiveness of the survival theme can be inferred from the qualitative responses students provided to questions such as "what did you enjoy most about the inquiry session?" The number of responses to this that explicitly mentioned 1) the survival theme, 2) the use of audio/visual elements, 3) the group work aspect of the session and 4) the hands-on aspect of the session are shown in Figure 5. Some responses to this free-form question included explicit reference to more than one of the four areas, such that the total number of responses in these four categories is larger than the total number of student evaluations that were considered. Responses that were ambiguous or referred to aspects of the session like "snacks" or "free t-shirts" that were not relevant to our evaluation were removed from consideration.

It is noteworthy that these were not responses to multiple choice questions that prompted specific answers, and that, while the results are ambiguous as previously noted, students nevertheless felt the theme or scenario was worth mentioning as often as the hands-on activity (Figure 5). It is interesting to compare these results to the students' response to the question "what did you enjoy *least* about the inquiry exercise?" where the number of responses with explicit reference to the same four aspects identified in Figure 5 are shown in Figure 6.

While many students felt frustrated by the hands-on activity and didn't enjoy the group work, only one student responded negatively regarding the choice of the survival theme.

General Implementation and Examples

What is a reasonable approach to follow in attempting to implement this strategy in the science classroom? Where the

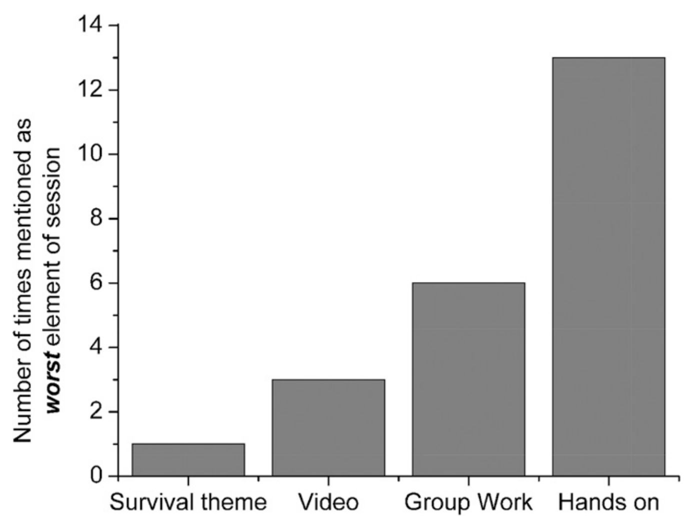

Figure 6. Survey responses from 70 secondary school students collected after their participation in a multi-disciplinary, survival-themed inquiry session. The number of responses to the question "what did you enjoy least about the inquiry exercise?" explicitly mentioning the four most popular answers are shown

learning outcomes are based in curricula, an approach to utilizing this theme that is consistent with current design-down practices would involve defining the objectives, followed by the development of strategies likely to achieve them. This is not necessarily straightforward for the science teacher without a depth of experience in survival skills or familiarity with this theme. Simply picking a particular aspect of disaster survival and searching for the appropriate scientific learning outcomes may not be an efficient way to plan a lesson. As such, a general overview of suggested survival topics is given in Table 1, matched with common strands within elementary and secondary science curricula and references to published lesson plans.

Inspiration for other lessons that utilize this theme in addressing the expectations of an elementary or secondary school science curriculum may be found in survival handbooks, Scouting manuals or general camping information. The science educator will not find explicit links to the scientific principles behind these skills in the pages of such manuals, but after only a few attempts we predict making the connections between scientific learning goals and details within this engaging theme will become second nature to many teachers.

Conclusions

If a student learns about the most critical elements in making a water filter and what the limitations of that filter are, are they better-equipped to make decisions about water quality in your own community? Can improved knowledge of the minimal nutrition necessary to survive a disaster scenario inform weekly grocery choices or discussions at home about meal planning? Using a problem like the survival scenario as a teaching method can form a connection between everyday experiences and the lessons of the classroom, and this approach lends itself well with the science curriculum standards and learning outcomes which are increasingly being framed through a constructivist lens (Goodnough & Cashion, 2006).

The *surviving the disaster scenario* is a very rich field for science experimentation and inquiry-based, constructivist teaching. The lessons are exciting (there is always at least an implicit level of risk and danger associated with this subject) and the results are dramatic and easily relatable. The idea that one could potentially need these skills if ever in a survival situation also provides students with a reason or purpose to learn. It answers the age-old question, "when am I ever going to use this information?" Increasingly, students are travelling abroad to the many places where simple survival skills are necessary. In many parts of the world, understanding the disaster scenario and knowledge of survival skills are not fantastic or hypothetical, and teaching students more about this scenario can have far-reaching impact.

We have presented a case for the general success of this theme in science classrooms at many levels, based both on commonalities with successful approaches and on data gathered from classroom and outreach science experiences. We present a brief guide to the implementation of this theme that we hope will increase opportunities for success amongst teachers and students alike in the science classroom, and we encourage other educators and researchers to add their experiences in this area to the public domain.

Table 1. Different topics addressed in elementary and secondary school science curricula and some suggested topics that enable the use of a disaster-survival theme

Science strand or unit	Suggested survival-themed topic
Physics, Structures, Mechanisms	
Properties of materials	Selection of materials suitable for construction of basic shelters, tools
Tension and compression	Ropes and tarps used to make simple shelters
Simple Machines	Making survival tasks easier; removing obstacles; snares and deadfalls
Work and Efficiency	Energy conservation; surviving exposure through insulation; minimizing energy expenditure; energy requirements for life
Work, Pressure, and Energy Transfer	The design of simple weapons, shelter supports
Friction	Making and maintaining fire
Geometric optics, Lenses and Mirrors	
Chemistry, Matter, Energy	
Combustion	Making and maintaining fire; selection of fuel sources; dangers associated with incomplete combustion products
Heat transfer	Insulation and preserving heat (Science Teacher's Association of Ontario (STAO), 2011); cooking
Pure substances and mixtures	Separation; distillation; water purification
Energy	Nutrition and energy requirements for survival (Penn State Public Broadcasting, 2006)
Biology, Life Systems, Sustainability	
Needs and characteristics of living things	Daily requirements of water, warmth, and food
Food chains and biodiversity	Predators and disease (Rucker, 2005); energy requirements of life; pathogenic organisms in water and food; water purification
Growth and changes in Plants	Growing food; foraging; plant identification
Earth Science, Space, Environmental Science	
Weather	Natural disasters; clothing and shelters appropriate for surviving exposure (Smart Exchange USA, 2012)
Water Systems	Water purification, disinfection (Engineers Without Borders, 2004; Heinecke, 2012); desalination (WaterSecure, 2011)
Soil, rocks, minerals	Requirements for fertile soil; materials for tools (Judson, 2007)
Astronomy	Navigation, orienteering (The Institute of Navigation, 2003)

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Disclaimer: The manuscript does not contain clinical studies or patient data. This study utilizes anonymous data that cannot be used to identify those involved. The data was collected for purposes other than the research described here, and according to Article 2.4 of the 2nd Edition of the Government of Canada's Tri-Council Policy Statement: Ethical Conduct for Research Conducting Humans, the research described in this manuscript is exempt from Research Ethics Board approval.

Appendix A: Survey Administered to Education Students:

Throughout the 2012/2013 year, there have been several GSCI 1000 lectures surrounding the idea of preparing for disasters and survival-type situations by learning elementary science. Please complete the following questionnaire so that I can evaluate the effectiveness of this approach.

Your responses will be kept completely anonymous and are voluntary: if you don't feel like answering, you don't have to.

For the following questions, please indicate your evaluation by filling in the square, where the numbers indicate these responses:

1 – Strongly disagree 2 – Disagree 3 – Neither agree nor disagree 4 – Agree 5 – Strongly agree

1. Demonstration of the relationship between chemical reaction rate and surface area was clearer using Alka-seltzer tablets at home than the explosive "firestarter" example at the front of the class (where a pile of powder didn't explode, but a cloud of it did).

   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

2. Learning how fire is made with two sticks makes concepts like the normal force and friction clearer than learning why we take small steps on icy surfaces.

   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

3. When I think of having difficulty finding water in a disaster, it makes lessons about water filters and pollution more engaging than if we had just made the filters.

   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

4. I find it easier to remember lessons from lecture about photosynthesis, soil and biodiversity (when the relevance to the curriculum was made clear) than the lessons about growing food, composting and preserving food (when personal survival was the focus).

   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

5. It was clearer to learn about stability, strength, tension and compression when making structures with toothpicks and play-doh than when we discussed building shelters with wood, ropes and tarps.

   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

6. Learning how climate change may destroy civilization made discussions of energy efficiency more engaging for me than discussion of nutrition and trophic levels did.

   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

7. I find that when learning about science concepts using the "vehicle" of post-apocalypse survival, the lessons stay with me longer than those lessons taught outside of this theme.

   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5