Interdisciplinary Journal of Environmental and Science Education
2023, 19(4), e2315
e-ISSN: 2633-6537
https://www.ijese.com/

MODESTUM

Research Article

OPEN ACCESS

Impact of an adventure geology STEM camp on outdoor self-efficacy

Robert C. Burns [1*], Lauren Janowicz [2], Dave Smaldone [1], Chad Pierskalla [1], Jasmine Cardozo Moreira [3]

[1] West Virginia University, Morgantown, WV, USA
[2] Farmington Hills Recreation, Farmington Hills, MI, USA
[3] Universidade Estadual de Ponta Grossa, Ponta Grossa, PR, BRAZIL
***Corresponding Author:** robert.burns@mail.wvu.edu

Citation: Burns, R. C., Janowicz, L., Smaldone, D., Pierskalla, C., & Moreira, J. C. (2023). Impact of an adventure geology STEM camp on outdoor self-efficacy. *Interdisciplinary Journal of Environmental and Science Education, 19*(4), e2315. https://doi.org/10.29333/ijese/13722

ARTICLE INFO

Received: 17 May 2023

Accepted: 04 Sep. 2023

ABSTRACT

Little research has sought to understand programs incorporating outdoor adventure recreation and STEM, or adventure STEM. An eight-day residential outdoor camp combining adventure activities with experiential education and geology-focused informal learning opportunities was developed and delivered to adolescents. The purpose of this exploratory study was to understand the impacts of this adventure STEM camp on adolescents perceived outdoor recreation self-efficacy (ORSE). Semi-structured interviews were conducted with 15 youth participants and content analysis was used to analyze the results. Experiential education theory and self-efficacy theory informed the curriculum design, as well as the interview questions. Results indicated there was a change in ORSE beliefs and that campers had unique, yet similar, experiences. These experiences aligned with Bandura's (1977) main sources of self-efficacy (SE) and the physiological processes through which SE beliefs are formed. Results indicated strategically adding more camp opportunities related to mastery experiences, reflection, and coping could further improve outcomes.

Keywords: outdoor education, adventure STEM, self-efficacy, adventure recreation

INTRODUCTION

Although research focused on understanding the impacts of outdoor adventure programming is plentiful, little research has sought to understand programs that specifically incorporate outdoor adventure recreation and STEM, or adventure STEM (Larsen et al., 2014; Mackenzie et al., 2018; NRC, 2015). Although adventure STEM as a distinct subfield is still being developed, it holds great promise to positively impact both academic and personal learning outcomes. As a precursor to encouraging STEM learning, this study focused on using outdoor adventure recreation activities that incorporated STEM curriculum to develop adolescent self-efficacy (SE).

The purpose of this exploratory qualitative study was to understand the possible impacts of an adventure STEM camp program on adolescents' perceived outdoor recreation self-efficacy (ORSE). This adventure STEM program linked outdoor adventure recreation and geology-focused STEM topics in a summer camp setting at West Virginia University's Outdoor Education Center. This study was focused on adolescent participants' perceived SE because of its importance in personal growth and academic achievement during this crucial developmental period in a person's life (Burns et al., 2023; Curtis, 2015). Moreover, SE is important because it has many implications for adolescent overall subjective well-being (Artino, 2012; Bandura, 1994; Bandura et al., 2001; Zimmerman & Cleary, 2006).

Recreation-Focused Outdoor Education & Adventure STEM

For adolescents, there are several benefits to linking STEM education opportunities and outdoor recreation (OR) in informal learning settings, including the variety of instructional practices that appeals to a diverse range of students (Denson et al., 2015; Mohr-Schroeder et al., 2014; NRC, 2009, 2015). Moreover, there are many benefits to outdoor education and recreation in general such as identity development, growth in emotional intelligence, opportunities to development autonomy, improvements in mental health, opportunities to overcome physical challenges, enhanced self-esteem, and improved SE (Duerden et al., 2009; Garst et al., 2001; Jones & Hinton, 2007; Passarelli et al., 2010; Paxton & McAvoy, 2000; Roberts et al., 2018; Schwartz & Belknap, 2017; Shellman & Ewert, 2010; Widmer et al., 2014). Combining outdoor adventure recreation with informal STEM learning is a logical next step in the outdoor education field.

This study sought to do that by developing an 8-day residential adventure STEM program involving adventure activities combined with outdoor education and geology-focused informal learning opportunities. The curriculum and activities employed were designed using a theoretical framework involving experiential education theory (Kolb, 1984) and self-efficacy theory (Bandura, 1977). The recreation activities included hiking, rock climbing, whitewater rafting, zip lining, environmental education, biking, fossil hunting, and geocaching. STEM lessons focused on geologic mapping, basic geologic concepts, historical geology of the Appalachian Mountains, and hydrology and environmental geology. The following literature review connects the field of outdoor experiential education and the budding use of adventure STEM to showcase how building SE is a useful first step in creating STEM interest, and then knowledge.

LITERATURE REVIEW

Perceived Self-Efficacy

Bandura (1977) described perceived SE as a person's belief in their ability to accomplish a certain task or achieve a specific goal. Bandura (1977) posited that SE beliefs have implications for one's subjective well-being, motivation, and can impact many parts of a person's life in that one's outcome expectancies have direct impacts on one's ability to perform behaviors. Bandura (1977) theorized that beliefs about one's SE can be developed through four main sources of influence: mastery experiences, vicarious experiences provided by social models, social persuasion, and somatic and emotional states. Recent research suggests that mastery of experience is often the most impactful of these main sources of influence, leading to a strong sense of SE across a variety of topics (Han et al., 2016; Yeh et al., 2019). Mastery experience involves overcoming obstacles through perseverant effort resulting in either a success or a failure and those with a high sense of efficacy have the staying power to endure these obstacles and setbacks that characterize difficult undertakings (Bandura, 1977, 1994). Those with high perceived SE will see a difficult task as a challenge that can be mastered while those with low perceived SE will view the same difficult task as a threat that should be avoided (Bandura, 1994).

Bandura also proposed four main ways to explain how SE effects people through different internal processes (Bandura, 1994). These processes include cognitive, affective, motivational, and selection or decisional. Cognitive processes describe how our thoughts related to our SE guide our decisions–the more people are likely to think optimistically or positively about doing something (for example, rock climbing) the more likely they will try and even succeed. On the other hand, if people think more negatively about their abilities to do something, the less likely they are to attempt it. A strong sense of SE in the face of difficulties, and our ability to cope with challenges, affect our choices and decision-making abilities. A second process, Affective, refers to how our emotions impact, and are impacted by, our thoughts. People who have a strong sense of SE do not allow themselves to "feel" bad for too long–they have coping skills to help push through difficulties. Our perceived SE connects with the levels of anxiety, stress, and even depression we feel. It should be clear that the link between our thoughts (cognition) and feelings (affect) are strong in this theoretical framework. Another process is motivational, and Bandura (1994) believed much of our behavior is cognitively generated. People have beliefs about what they can do, and they anticipate outcomes of their behavior. People with stronger SE will be more motivated to do a certain behavior, and then continue to try if they encounter difficulties. The last process, called selection, describes how SE influences the choices we make regarding everything from the activities we participate in, to the environments or contexts we put ourselves in. We seek out situations that we think we can handle or succeed in, and actively avoid activities and situations we believe are beyond our abilities, or our coping capabilities. Thus, these choices play an important role in determining our interests and even our friends.

The benefits a strong sense of SE provide can be especially important in the education setting for teenagers who are in a pivotal developmental phase of their lives (Zimmerman & Cleary, 2006). Research has shown that SE and motivation are closely related and children who have higher SE are more likely to engage in challenging learning activities (McGeown et al., 2014). Moreover, academic SE is linked to academic motivation and achievement and affects students' performance and learning behavior via their task choices, exertion, and perseverance (Artino, 2012; McGeown et al., 2014). Therefore, researchers have increasingly suggested that education professionals foster SE beliefs in students in addition to knowledge and skill building (Artino, 2012).

Informal Learning Contexts & Adventure STEM

Much research has been devoted to describing the theories and best practices employed by camps and other informal learning contexts to foster positive changes in youth (American Camp Association, 2005; NRC, 2009; Rogoff et al., 2016; Sasson, 2014; Smith-Palmer et al., 2015; Toomey Zimmerman & Bell, 2012). Unlike formal education, youth camp and informal education programs put personal growth at the forefront of programming goals and often use theories such as the experiential education theory (Kolb, 1984) in curricula to attain these changes while students learn, including topics like science. Moreover, difficult-to-comprehend topics such as STEM subjects can be made more interesting in an informal learning experience (NRC, 2015; Roberts et al., 2018). This increased interest in STEM is an important component in encouraging students to pursue STEM learning because it contributes to students' learning and success in retaining STEM content (Hossain et al., 2012; NRC, 2009; Roberts et al., 2018). There are various techniques and elements associated with informal learning programming, but the present study focuses on the outdoor youth adventure summer camp setting, more specifically referred to as adventure STEM (Burns et al., 2019; NRC, 2009, 2015).

The informal learning programming for the Appalachian GeoSTEM Camp utilized experiential education theory (Kolb, 1984) as the foundation to foster learning, and outdoor adventure recreation to foster STEM interest in participants while providing opportunities for personal growth and intellectual development, specifically SE. Kolb's (1984) experiential education theory is based on learning through

Table 1. Appalachian GeoSTEM Camp curriculum overview

Modules	Description & goals	Paired informal learning & recreation activities	STEM content
Basic mapping techniques	Use apps to navigate outdoors & collect scientific data. Helps campers get engaged with outdoors without intimidating them with too much information.	• Geocaching with GPS & paper topographic maps • iNaturalist BioBlitz hike with zip-lining • Rock climbing, structure from motion & drones	Science, technology, & engineering
Basic geologic concepts	Learn relevant geoscience concepts like rock cycle, rock, & mineral identification, geologic time scale, time principles & relationships, etc. Gives campers a geologic background.	• Visit to WVGES facility & museum including two rounds of four rotating & hands-on activities in each round • Concepts reinforced in later activities	Science, technology, engineering, & math
Historical ceology of Appalachian Mountains	Explore geologic history of Appalachian Region. Gives campers an idea of time & processes it took to get to present landscape.	• Day trip to see major geologic locations in WV • Whitewater rafting on Cheat River • Visit to Laurel Caverns	Science, math, & engineering
Geologic mapping	Application of knowledge learned in basic mapping, geologic concepts, & historical geology. Campers learn to record geologic data in StraboSpot application by taking pictures, adding notes, & using built-in compass to find strike & dip of fold-affected rocks.	• Day trip to see major geologic locations in WV • Deckers creek rail trail biking	Science & technology
Hydrology & environmental geology	Campers learn about remediation efforts to clean up effects of acid mine drainage from Cheat River & its tributaries. Overview of stream geomorphology, ecology, & local watersheds. Campers take scientific samples & record data using WV Department of Natural Resources practices.	• Stream assessment activities (macroinvertebrate collection/identification & measuring pH & conductivity) at Tibbs Run • Visiting an acid mine drainage treatment station • Environmental education activities	Science, technology, engineering, & math

experience. Experiential learning is process-focused and involves concrete experiences followed by reflective observation, abstract conceptualization, and active experimentation, and experiential learning requires a close interaction between the learner and the environment (Kolb, 1984). Learning through hands-on experience allows for more involvement in the subject matter and causes a pairing of concrete memories with knowledge, skills, and subject matter (Fägerstam, 2014; James & Williams, 2017).

Research regarding the utilization of experiential learning in educational and vocational programming has shown increases in participant SE beliefs (Banfield & Wilkerson, 2014; Esters & Retallick, 2013). The summer camp setting is an excellent environment for utilizing experiential learning theory and can even be considered the quintessential experiential classroom (Yilmaz et al., 2010).

Experiences in outdoor education, adventure, and recreation settings facilitate a multitude of positive affective and cognitive outcomes including identity development, increased self-confidence, resilience, intrinsic motivation, relatedness, autonomy, and well-being (Duerden et al., 2009; Houge Mackenzie & Hodge, 2019). Complementing classroom learning, more informal outdoor adventure education opportunities can lead to the development of skills, beliefs and behaviors that support student achievement in the classroom and beyond.

This set of intrapersonal and interpersonal assets (e.g., perseverance, grit, social skills, efficacy beliefs, and mind-sets) are desired outcomes, which outdoor adventure education is well positioned to deliver (Richmond et al., 2018). Research conducted over the last two decades has demonstrated the value of outdoor education, especially with a focus on experiential learning (Fägerstam, 2014; Finn et al., 2018; James & Williams, 2017; Mackenzie et al., 2018; Passarelli et al., 2010; Richmond et al., 2018).

Adventure STEM

Adventure STEM as a concept is sparse in current literature and there is little to no standardization of terms and definitions (Larsen et al., 2014; Mackenzie et al., 2018; Son et al., 2017). Adventure STEM is often either described using other terms such as "adventure learning", or inadequately applied–for example, organizations such as the Oak Grove School District say they have an adventure STEM design, but it appears they do not include outdoor adventure recreation in their programming (AdVENTURE, n. d.). The few programs comparable to the Appalachian GeoSTEM Camp (Burns et al., 2019), such as the South Dakota School of Mines Geology Rocks! Summer Camp (n. d.), involve some OR and STEM learning but without a high-caliber integrated adventure recreation component. Because this interdisciplinary field of adventure STEM is still emerging, evaluating and understanding outcomes and impacts of these types of programs is challenging (Fu et al., 2015).

2019 Appalachian GeoSTEM Camp

WVU and the United States geological survey (USGS) created the Appalachian GeoSTEM Camp (Burns et al., 2019) to give adolescent students experiences through which they can build interest in geology-focused STEM topics, undergo personal growth, gain confidence and self-identity, and establish positive SE beliefs. 2019 Appalachian GeoSTEM Camp was an eight-day, residential, experiential program, which combined outdoor adventure recreation activities with geology-focused STEM topics (see **Table 1**).

This was the first year of the camp, and camp leaders and instructors included trained college students (who led OR activities) as well as USGS full time employees (who led the GeoSTEM sessions). This summer camp took place in June of 2019 and included 18 participants who were between the ages 13 to 17 and entering 9th to 12th grade in school the Fall.

Table 2. Table on top of a page

No	Question	Major process(es)	Main source(s) of influence
1	At any point during camp, did you feel that there was a time you overcame an obstacle through a lot of effort?	Cognitive, affective, & motivational	Mastery experiences
2	Before this camp, did you think of yourself as someone who is good at adventuring outdoors? Have those feelings changed after participating in this camp? If so, how?	Cognitive & selection	Enjoyment/mood & interest
3	What does it mean to you to be good at outdoor adventure activities?	Cognitive	Enjoyment/mood, interest, mastery experiences, & vicarious experiences
4	How would you say that other people who know you, like your friends, teachers, & parents describe your interest & skill in outdoor adventure activities?	Cognitive & selection	Enjoyment/mood, interest, & vicarious experiences
5	After participating in camp, are those feelings changed? If so, how?	Cognitive, affective, & selection	Enjoyment/mood, interest, & vicarious experiences
6	Prior to this camp, how did you feel about doing outdoor adventure activities such as hiking, biking, climbing, or rafting? How do you feel about doing outdoor activities such as these after participating in camp?	Cognitive, motivational, & selection	Enjoyment/mood, interest, mastery experiences, & vicarious experiences
7	Have you ever wanted to quit doing outdoor adventure activities because of a specific experience? If so, what happened & how do you feel you handled situation?	Cognitive, motivational, & affective	Mastery experiences
8	Some would say that a lot of the activities you participated in during this camp are dangerous & risky. Do you feel that you can handle pressure well when participating in these types of outdoor adventure activities? What do you do to help cope with any pressure?	Cognitive, affective, & selection	Enjoyment/mood, interest, mastery experiences, & vicarious experiences

This camp is one of a few, if not the only geology-focused, adventure STEM camp that incorporates high-impact outdoor adventure recreation activities such as whitewater rafting, rock-climbing, and zip-lining. The program blended best practices in adventure recreation, informal learning, outdoor education, experiential learning, environmental education, and traditional summer camp (Janowicz, 2020).

MATERIALS AND METHODS

This exploratory study employed a qualitative approach (Hsieh & Shannon, 2005). Convenience sampling was used because participants voluntarily selected to attend and participate in the program (Dykas & Valentino, 2016; Ilker et al., 2016). Study participants included 15 of the 18 adolescents who completed the program with five (33%) males and 10 (66%) females. 80% of participants were from West Virginia, and were recruited through email blasts, flyer dissemination, social media posts and advertisements, school guidance counselor outreach, camp webpages, and word-of-mouth. There was no cost to participate in the camp.

Semi-structured interviews were used to collect data from all camp participants who consented. Three trained researchers conducted and recorded interviews using digital recorders with five campers each during evening activities on the last evening of camp. The researchers were not part of the camp, and had limited interactions with the youth campers prior to, during, or after camp. The length of the interviews ranged from seven to 23 minutes. The interviews used questions (see **Table 2**) developed from Bandura's (1994) self-efficacy theory, Bandura's (2005) guide to constructing SE scales and Mittelstaedt and Jones's (2009) ORSE scale. Open-ended questions and prompts asked students to talk about their experiences in the camp program and how they felt about their skills and abilities in different OR activities. This study sought to understand the experience of an activity or concept from the perspective of the camp participants (Ary et al., 2009).

Directed content analysis was used in the study because existing theories (noted above) were used to focus the research questions and guide the coding process, and due to the large amount of text and contextual information available to the researcher (Hsieh & Shannon, 2005; Mayring, 2000). Using Dedoose software, data from the interviews were transcribed and analyzed (Hsieh & Shannon, 2005; Neuendorf, 2017). Using Saldaña's (2013) coding methods and directed content analysis (Hsieh & Shannon, 2005), a-priori coding was conducted repeatedly to familiarize the researcher with the data and to begin to break the data into individually coded segments. Then, first cycle coding was carried out using empirical observation without considering a priori codes. During initial coding in the first cycle, self-efficacy theory was used as a guide to identify key concepts and establish coding categories (Hsieh & Shannon, 2005). The researcher focused on participant experiences and how they corresponded with Bandura's (1994) four major processes and four main sources of influence of SE. With this guiding theory, operational definitions for each category were determined (Hsieh & Shannon, 2005). Codes were the labels created and used by the researcher in the process of identifying and indexing themes in responses, while themes are the concepts pulled by the researcher from participants' perceptions and described experiences the researcher saw as relevant to the research questions. During the second cycle of coding, the researcher employed focused coding (Saldaña, 2013) to merge and drop codes as needed while further editing codes established in the first round of coding. Focused coding led to the development of broader categories in the data and required decisions about which initial codes would be dropped (Saldaña, 2013). During both main coding cycles, the researcher concurrently maintained analytic memos. Post-coding and pre-writing transitions involved the development of main categories based on emergent themes (Saldaña, 2013) and themes were

subsequently developed and fine-tuned (see **Appendix A** for final coding structure).

RESULTS AND DISCUSSION

For brevity sake as well as conceptual connectedness, the results and discussion are reported together in this section. All of the participants pointed to SE-related experiences, which took place during OR activities in the camp, and described their perceptions of the subsequent physiological processes related to those experiences. The results indicated that each camper experienced an increase in SE in their abilities related to OR. Using physiological processes by which SE beliefs are formed (Bandura, 1994), the data demonstrated that although participants experienced changes in their SE during their participation in unique ways, they all shared overarching similarities in these processes. The data indicated an increase in participant OR-related SE due to a variety of factors and experiences. This result was expected given that empirical research findings regarding the utilization of experiential learning in educational and vocational programming have shown increases in participant SE beliefs when this theory is applied (Banfield & Wilkerson, 2014; Esters & Retallick, 2013).

The experiences that participants described aligned with Bandura's (1977) main sources of SE and the physiological processes reported fit with his described processes through which SE beliefs are formed. The adventure STEM camp studied appeared to be an effective place to foster personal growth by way of establishing and improving perceptions about OR-related task-specific confidence for these adolescents. ***Notably, analysis found the evidence that two (of the four) main sources of self-efficacy were present, and that all four of the main processes of SE impacted participants.*** The two main sources of SE found were mastery experiences and emotional and physiological states. *Related to the processes, the following six factors emerged as the most important and will be explored:*

1. confidence levels,
2. the perceived challenge of activities,
3. self-described strong motivation levels to participate in OR activities,
4. coping abilities related to difficult or risky OR activities,
5. previous experiences, and
6. a high interest in OR activities prior to attending camp.

Illustrative quotes will be used to highlight the relevant findings, and campers have been given pseudonyms.

Sources of Self-Efficacy

Mastery experiences (Bandura, 1994) were a part of each participant's adventure camp experience and were an integral part of how SE beliefs and perceptions were formed due to their camp participation. All 15 participants were able to describe at least one event that took place during the camp, where they had to overcome obstacles through great effort and perseverance. Additionally, many participants discussed feeling a sense of accomplishment after a mastery experience. For example, one male student, Eric, age 15, described how he overcame not believing in his rock-climbing abilities, pushed through a challenging experience, and eventually completed the task of reaching the top of the rock face successfully.

> 'So, at first, I thought it was beyond my physical capabilities because when I reached up, I physically could not get up. Then I realized mentally it's like I just made that little jump to get to that next arm hold then I could make it up the rock and I did that each time I found the problem and I used that to find the solution. I just made that little jump each time and slowly I made it all the way up the rock.'

The prevalence of this experience reported by participants demonstrates that programs like the Appalachian GeoSTEM Camp setting can be a beneficial environment for personal growth while learning important STEM topics. OR and summer camp programs provide numerous opportunities for mastery experiences to occur, so this outcome was expected and supports findings in previous research (Bell et al., 2016; Duerden et al., 2009; Hogue Mackenzie & Hodge, 2019; Lane et al., 2013; Locklear, 2013; Wilson et al., 2019; Ye et al., 2019).

The **second main source of SE** noted by participants related to what Bandura (1994) termed **emotional and physiological states**. Three aspects of this were noted within the interviews. First, all campers mentioned *they enjoyed participating in OR activities in their lives and at the camp specifically*. The enjoyment levels of the campers while they participated in the camp led to more positive feelings about themselves in the roles they fulfilled during activities. Thirteen-year-old Georgia spoke many times about her enjoyment of OR activities. When asked how her feelings about these activities were impacted after camp participation, Georgia stated,

> 'I still really like them. I do not think there's anything that I had a bad experience with. I think they're all like super fun and even with the new stuff I tried because I've never gotten so far before either and they were all really, really fun.'

Bandura (1994) described how enjoyment of an activity can often lead to a higher motivation to participate in that activity, which can then lead to improved SE beliefs. Fun and enjoyment often go hand-in-hand with the camp setting due to friend-making, achievement, positivity, and safety (Garst & Whittington, 2020) as well as the many fun OR activities in which campers participate. Combining this inherently fun setting with difficult school topics that are often taught in more formal settings (Ngaka et al., 2012) may help improve the learning experience and possibly provide opportunities for increased motivation to learn about a challenging topic and/or increased SE beliefs regarding a challenging topic.

Second, as Bandura (1994) suggests, mood, or emotional and physiological state, also *impacted the participants' enjoyment level of camp activities and therefore the campers' perceptions of themselves in participation* (noted by 13/15 campers). The campers reported their mood would often also lead them to make decisions about their performance in OR activities, with campers who were in a bad mood or who were tired enjoying certain activities less.

Campers expressed feelings of excitement, exhaustion, and fear as some of the emotional and physiological states that impacted their task-specific feelings. Although it was only mentioned a handful of times, feeling fatigued and not enjoying an activity could have prevented those campers from pushing themselves to challenge themselves in an activity and therefore may have missed out on opportunities to improve SE beliefs. Ruby (15 years old) tied her dislike of an activity to her physiological state when she said,

> 'I did not really did not like the geocaching [activity] because it was right after a long hike, and I was kind of tired.'

On the other hand, another camper said that feeling tired helped improve his experience in the same activity:

> 'Yeah, I really liked geocaching. That was really exhausting.' (Milo, age 17).

Due to the inherently physical nature of OR activities and the positive, fun, challenging qualities of the camp setting (American Camp Association, 2005; Garst et al., 2001; Mackenzie et al., 2018; Martin, 2018; Passarelli et al., 2010), this fatigue was not unexpected.

Third, participants' *perceived and/or actual physical capabilities impacted their beliefs about their task-specific performance* during the camp (mentioned by 9/15 campers). Encountering situations, where physical capabilities needed to be assessed forced campers to think about their OR abilities. This was a common occurrence at the camp as activities such as rock climbing, whitewater rafting, and ropes courses happened daily. For example, Eric (15 years old) spoke about his initial feelings regarding his rock-climbing skills, saying,

> 'So, at first I thought it was beyond my physical capabilities because like when I reached up, I physically could not get up.'

This reflection on OR abilities therefore impacted participants' SE beliefs and sometimes their behaviors. This theme demonstrates yet another opportunity for task-specific self-confidence development provided by the unique adventure STEM camp setting. Similar to mood impacting participants' enjoyment of activities, the quality of the adventure STEM program being inherently physical meant that this outcome was not unexpected (American Camp Association, 2005; Garst et al., 2001; Mackenzie et al., 2018; Martin, 2018; Passarelli et al., 2010).

In regards to the other two sources of SE in Bandura's theory, about half (seven of 15) camp participants spoke about ***vicarious experiences*** provided by social models (Garst & Whittington, 2020; Wilson et al., 2019). For example, when speaking about the camp activities overall and how she had newfound motivation to pursue similar activities due to her peers' successes, Marcia, age 14, said

> 'since I saw my friends being able to do it too, it was really helpful.'

Lastly, only two (of 15) specifically mentioned ***social persuasion*** as being important. Faye (age 15) spoke about her fear and anxiety leading up to the zip-lining activity and how it was hard to overcome negative feelings and imagery until the counselors verbally guided her through the experience. She stated

> '… the counselors really coached me through it, and they were really nice about it, and I eventually did it so that was cool.'

She went on to emphasize that the experience has given her confidence to participate in the activity again in the future.

Processes of Self-Efficacy

Evidence was found for the influence of all four of the main processes laid out in Bandura's SE theory (1994), and each will be briefly discussed. ***With respect to cognitive processes, three important themes emerged.*** First, all participants communicated that *their confidence levels impacted their beliefs about their abilities and/or their behaviors* during the camp. According to the interviewees, the camp setting caused campers to think often about whether or not they felt confident enough to complete a task and why. Furthermore, interviewees reported an increase in confidence after participating in camp activities. When asked about her confidence in OR activities, Billie (15) commented,

> '[The camp] taught me some more things I did not know I could do … like rafting and stuff … the climbing. I mean, I knew I could do it, but I just did not know I had the nerves to do it.'

Campers reported that the specific camp setting increased their confidence in themselves in general and in their specific OR abilities. Related to cognitive processes and confidence, a sub-theme emerged–*all campers also spoke about how their previous experience contributed to their perceived OR skill and knowledge levels and those perceptions impacted their task-specific confidence* with some mentioning that their skills had improved (Bandura, 1994). Campers believed that experience in OR activities caused an increase in OR knowledge and skill and that participation in the camp caused an increase in these factors. In short, participation in the adventure STEM camp caused an increase in factors directly related to both general SE and OR-related SE. Due to its utilization of informal learning techniques, the summer camp setting, and OR activities (American Camp Association, 2005; Garst et al., 2001; Mackenzie et al., 2018; Martin, 2018), this adventure STEM camp setting provided many novel opportunities for campers to use knowledge and confidence gained from previous experiences throughout the program.

A second cognitive process theme involved expectations–most campers (13/15) said they either had some sort of *expectation of the camp* and what camp activities would be like, or specifically stated their expectations of the camp and its activities. They especially did this when discussing OR activities that are inherently challenging, and while some were excited a positive, some were uncertain and worried. Ruby (15) noted,

> 'I had never really been camping and stuff and I was excited for that. It just seemed really fun … It was kind

> of like the whole thing that seemed exciting and seemed like a good thing, a good experience to have.'

This theme further illustrates that the adventure STEM camp process fosters reflection about SE beliefs related to OR activities.

The last theme dealing with cognitive processes was that campers' *perceived mental state* impacted their SE feelings and behavior during the different OR activities in which they participated (noted by 12 out of 15). Participants all had a wide variety of perceptions of their mental state and how they felt it impacted them. While some campers mentioned how keeping calm helped them get through stressful situations, others spoke about how their perceived control of their mental state was their biggest aid. The setting put participants in situations, where they reflected on their mental states during stressful and risky OR activities and had to practice skills related to these states. As an example, Eric (15) elaborated about his perceptions of the impact his mental state has on his abilities during risky OR activities, saying,

> '... I usually just remain calm under pressure because like if you do not remain calm, then you might get a little flustered and you will not be your usual self like when doing certain physical activities like whitewater rafting, which will affect your ability to do different stuff.'

The wide variety of feelings about their mental states during these activities were all described as impacting their beliefs about task-specific confidence or efficacy. This theme is in line with Bandura's (1994) statements about the role that mental state has in the development of SE and our coping skills.

A second process by which SE beliefs affects people is **motivational processes**. Bandura (1977, 1994) argued that most behavior is motivated by thoughts, including setting goals, anticipating outcomes, and forming beliefs about what we can do. In this study, three themes emerged related to motivational processes. Results indicated that thoughts about ***perceived challenge*** impacted participants' feelings about their OR abilities or their participation in OR activities in a variety of contexts, and they often simply pointed out whether they felt a specific activity was challenging or not (mentioned by 15 out of 15 participants). Georgia, age 13, implied that feeling challenged helps improve her OR abilities, stating

> 'I still get really, really tired on long hikes and stuff and I hike a lot. So I feel like I do not have a lot of skill with it, but I try to improve my skill like every time I go.'

Feeling challenged or not challenged was an important factor in participants' experience during the camp, which impacted motivation to participate in OR activities. Campers sought out challenges and often exerted greater effort when they were attempting to master a given challenge, indicating a strong belief in their capabilities (Bandura, 1994). Opportunities for challenging moments are extremely common in adventure camp settings (American Camp Association, 2005; Garst et al., 2001).

A second theme related to motivational processes was that all campers mentioned they had a strong motivation to participate in OR activities, with the majority mentioning a high motivation to participate in similar activities in the future (12/15). For example, Ruby (15) said,

> 'I mean, before this I probably would never actually voluntarily go on a hike, but I think now if I found something like trails in my area or whatever area I'm in I would probably, like, go on a hike or something.'

Thus even though all had talked about being motivated to participate in OR activities prior to camp (although the extent of their prior participation varied considerably), the majority talked about wanting to continue or even do more OR in the future, indicating an increase in OR activity-related SE. This increase could be attributed to the often-mentioned self-satisfying experiences, which the campers had during the camp, which impacted their motivation to participate in similar activities in the future (Bandura, 1994). This increase can also be compared to other affective and cognitive impacts on those who participate in informal learning, OR, and summer camp programming (Bell et al., 2016; Duerden et al., 2009; Houge Mackenzie & Hodge, 2019; Lane et al., 2013).

Thirdly, all participants also spoke about their perceived abilities in exercising self-influence during the camp while participating in OR activities. The camp provided a setting in which campers reflected on their abilities to exercise self-influence in OR situations on their own. After being asked about his feelings about his coping abilities, fifteen-year-old Harris pointed to his own self-influence when he said

> 'I run a lot of scenarios in my head all the time ... even though it's scary, we're going to get through it and that's what I like about it. It's like, it's in your hands whatever you do.'

These feelings impact motivation to participate in goals and tasks and are therefore integral to the development of SE beliefs (Bandura, 1994).

The third process described by Bandura (1977) is **affectiv**e, or how our thoughts affect our feelings about whether we can do a task, including how much stress and anxiety we feel, as well as our coping abilities. In this Affective domain, two main themes emerged. First, all campers discussed *perceptions related to their coping abilities and skills* while participating in OR activities. They specifically talked about staying calm, keeping a clear mind, listening to those around them, and telling themselves to push through challenging situations. As an example, Marcia, aged 15 said,

> '... I think in both, I was really relying on myself and like, I have to be able to trust myself in order to get it done. Like it was just kind of hard to remember that I am in control and that, if I freak out like I'm not going to do as well.'

Campers described having been given opportunities to reflect on their perceived coping SE, which "regulates avoidance behavior as well as anxiety arousal" (Bandura, 1994), during the camp. Participants appeared to show a strong sense of SE in this area, therefore demonstrating their

likelihood of taking on challenging and threatening OR activities such as those experienced in the camp (Bandura, 1994).

A secondary Affective process theme was also noted. Many campers (11 out of 15) *enjoyed the perceived risk* associated with the camp OR activities. The enjoyment of perceived risk associated with camp activities further demonstrates the motivations of participants. 16-year-old Layla spoke about her enjoyment of feeling accomplishment as well as an enjoyment of the associated risk.

> 'When we were rock-climbing, when I got down, it was a really good feeling that I had accomplished something, and I like that feeling of accomplishment when I do something dangerous or risky, I guess.'

The inherent challenge of risky activities is enjoyed because it is a part of the self-satisfying reaction to success of one's performance (Bandura, 1994). In other words, campers enjoyed succeeding in risky challenges during the camp, and this enjoyment served as a motivation process through which SE beliefs can be formed.

Finally, in regard to **selection,** the fourth process identified by Bandura (1977, 1994), two important themes emerged. Selection processes focus on how our choices relate to the activities or setting we choose, and those in turn, further influence our SE. In this study, all participants also discussed *previous OR experiences* when thinking about their abilities and while making decisions during specific OR activities during the camp. Bandura (1994) pointed out that the processes of creating SE beliefs involve experiences that help people develop knowledge and skill and, consequently, impact beliefs about what they can accomplish. Most campers were able to point to previous OR experiences during activity participation during the camp. For example, Joni (17), claimed that even though she did not have a lot of experience in one activity, her previous experience in other challenging OR activities made her feel more confident at camp. It may also be inferred that campers may use their experiences in the adventure STEM camp in the future when making decisions about similar OR activity participation.

Secondly, all participants noted they had a *high level of interest in OR activities prior* to coming to the camp, often speaking about how this interest impacted their behaviors during activities. Some mentioned that this interest is what caused them to choose their camp participation in the first place. All participants were not experts in the OR activities at camp, nor had they all participated in all the activities prior to camp. However, the selection process of choosing to come to the camp, and then to participate in the various OR activities, served to strengthen their OR SE. Layla, aged 16, spoke about her enjoyment of and interest in OR activities when she said,

> 'I mean, I like being outside. I like doing sports and all the outdoor activities. Just all of it. I really enjoy it and it makes me very excited when I do it …'

Thus not only does this described high interest indicate prior strong interest and potentially SE beliefs in the campers, but the positive experiences most had at camp will likely feed back into further motivation for continued OR participation when faced with challenges in similar settings (Bandura, 1994).

Limitations

Several limitations of the study are noteworthy and are important to consider. Although all the campers were adolescents, this convenience sample is not representative of the broader adolescent population. Nonprobability sampling techniques such as convenience sampling are subjective in nature and are therefore not a good representative of the population (Ilker et al., 2016). Additionally, there was no control group utilized for the study. As noted earlier, a majority of the campers were already experienced in OR activities and were eager to experience the unique activities the program provided. Additionally, over half of the campers were from the same region (West Virginia). Although the data is not generalizable to the larger adolescent population (Ilker et al., 2016), the purpose of this exploratory qualitative study was to gain a greater understanding of the topic (Mayring, 2000). With appropriate methodology, future studies may generate generalizable results.

CONCLUSIONS

The summer camp setting was beneficial in providing opportunities for personal growth (Garst & Whittington, 2020) and based on the findings of this study, the adventure STEM camp setting was an excellent environment for improving adolescents' OR-related SE. Moreover, this setting can also provide many positive affective and cognitive outcomes including identity development, increased self-confidence, resilience, intrinsic motivation, autonomy, and well-being (Duerden et al., 2009; Houge Mackenzie & Hodge, 2019). Along with the benefits that informal learning contexts (i.e., camps), experiential education, and OR all bring to an adventure STEM experience, this study shows that improved SE related to OR activity performance is another outcome of participation in this type of setting.

In campers' reflections about their experiences, it appears they experienced an increase in perceived SE and task-specific confidence related to OR activities. This adventure STEM camp appeared to be an effective place to foster personal growth by establishing and improving perceptions about OR-related task-specific confidence for these adolescents. In alignment with Bandura's (1994) described physiological processes by which SE beliefs are formed, the results show that participants shared overarching similarities in the processes by which they experienced changes in their SE during their participation. The most common factors impacting most of the participants' perceptions and beliefs about their OR-related SE involved sources and processes identified by Bandura (1977, 1994). Here, these sources included mastery experiences and emotional and physiological states, and various subthemes related to the processes by which SE forms and impacts people. In this study, these included confidence levels, the perceived challenge of OR activities, strong motivation levels to participate in the activities, coping abilities, previous experiences, and a high interest in OR activities prior to attending the camp.

The outcomes of this study add to the limited body of literature about the understanding of adventure STEM program impacts on adolescents (Larsen et al., 2014; Mackenzie et al., 2018; Son et al., 2017). It will also provide camp managers with information that could potentially improve future Appalachian GeoSTEM camps. Some recommendations include placing a greater emphasis on reflection after participation in an activity to allow for campers to observe and contemplate feelings related to their SE perceptions. This added reflection would also be beneficial in solidifying learned concepts in the process of experiential learning (Kolb, 1984). Moreover, the opportunities for reflection of these experiences allowed for campers to explore their beliefs and feelings about their abilities and confidence related to OR activities. Camp program managers could also put more of an emphasis on activities in which mastery experiences are formed such as whitewater rafting, zip-lining, and rock climbing. Lastly, camp managers could expand the curriculum to include a requirement by camp leaders to teach participants about coping skills during high-stress OR activities. Based on the described perceived coping abilities and skills seen in the data, campers' experiences and SE perceptions improved when they felt confident in their coping abilities and skills during the camp. Linking these strategies more strongly to curriculum can help campers increase SE perceptions in the future.

Author contributions: All authors have sufficiently contributed to the study and agreed with the results and conclusions.

Funding: This study was supported by the US Geological Survey (USGS) under grant number G18AC00375.

Acknowledgements: The authors would like to thank the camp leaders and participants as well.

Ethical statement: The authors stated that the study was approved by the West Virginia University Institutional Review Board, IRB Protocol number 1810326379, dated 12/1/2018. Informed consents were obtained from the participants.

Declaration of interest: No conflict of interest is declared by authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

REFERENCES

adVENTURE. (n. d.). *Adventure*. https://adventure.ogsd.net/

American Camp Association. (2005). *Youth development outcomes of the camp experience*. https://www.acacamps.org/sites/default/files/resource_library/report-directions-youth-development-outcomes.pdf

Artino, A. R. (2012). Academic self-efficacy: From educational theory to instructional practice. *Perspectives on Medical Education, 1*, 76-85. https://doi.org/10.1007/s40037-012-0012-5

Ary, D. J., Cheser, L., Razavieh, A., & Sorensen, C. (2009). *Introduction to research in education.* Wadsworth Publishing.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215. https://doi.org/10.1037/0033-295X.84.2.191

Bandura, A. (1994). *Encyclopedia of mental health*. Academic Press.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman and Company.

Bandura, A. (2006). Guide for constructing self-efficacy scales. In F. Pajares, & T. Urdan (Eds.), *Self-efficacy beliefs of adolescents*. Information Age Publishing.

Bandura, A., Barbaranelli, C., Caprara, G. V., & Pastorelli, C. (2001). Self-efficacy beliefs as shapers of children's aspirations and career trajectories. *Child Development, 72*(1), 187-206. https://doi.org/10.1111/1467-8624.00273

Banfield, J., & Wilkerson, B. (2014). Increasing student intrinsic motivation and self-efficacy through gamification pedagogy. *Contemporary Issues in Education Research, 7*(4), 291-298. https://doi.org/10.19030/cier.v7i4.8843

Bell, J., Falk, J., Hughes, R., Hunt, G., Parrish, J., & Sacco, K. (2016). *Informal STEM education: Resources for outreach, engagement and broader impacts.* Center for Advancement of Informal Science Education.

Burns, R. C., Carter, M., Brock, J., Leveque, J., Bunse, E., Palaseanu-Lovejoy, M., Guala, G., Harlan, N., Blake, M., Moreira, J., Britton, J., Ashton, K., Nugent, B., Marketti, M. (2019). The Appalachian Geo-STEM Camp: Learning about Geology through experiential adventure recreation. *The Professional Geologist, 56*(2), 27-31.

Burns, R. C., Janowicz, L., Cardozo Moreira, J., Pierskalla, C., Andrew, R., & Smaldone, D. (2023). Adventure recreation camp: An informal education methodology used to educate youth. *Journal of Park and Recreation Administration, 41*(3), https://doi.org/10.18666/JPRA-2023-11581

Curtis, A. C. (2015). Defining adolescence. *Journal of Adolescent and Family Health, 7*(2), 2.

Denson, C., Austin, C., Hailey, C., & Householder, D. (2015). Benefits of informal learning environments: A focused examination of STEM-based program environments. *Journal of STEM Education, 16*(1), 11-15.

Duerden, M. D., Widmer, M. A., Taniguchi, S. T., & McCoy, J. K. (2009). Adventures in identity development: The impact of adventure recreation on adolescent identity development. *Identity, 9*(4), 341-359. https://doi.org/10.1080/15283480903422806

Dykas, M.J., & Valentino, D.W. (2016). Predicting performance in an advanced undergraduate geological field camp experience, *Journal of Geoscience Education, 64*(4), 314-322. https://doi.org/10.5408/15-128.1

Esters, L. T., & Retallick, M. S. (2013). Effect of an experiential and work-based learning program on vocational identity, career decision self-efficacy, and career maturity. *Career and Technical Education Research, 38*(1), 69-83. https://doi.org/10.5328/cter38.1.69

Fägerstam, E. (2014). High school teachers' experience of the educational potential of outdoor teaching and learning. *Journal of Adventure Education and Outdoor Learning, 14*(1), 56-81. https://doi.org/10.1080/14729679.2013.769887

Finn, K. E., Yan, Z., & McInnis, K. J. (2018). Promoting physical activity and science learning in an outdoor education program. *Journal of Physical Education, Recreation and Dance, 89*(1), 35-39. https://doi.org/10.1080/07303084.2017.1390506

Fu, A. C., Peterson, L., Kannan, A., Shavelson, R. J., & Kurpius, A. (2015). A framework for summative evaluation in informal science education. *Visitor Studies, 18*(1), 17-38. https://doi.org/10.1080/10645578.2015.1016363

Garst, B., & Whittington, A. (2020). Defining moments of summer camp experiences: An exploratory study with youth in early adolescence. *Journal of Outdoor Recreation, Education, and Leadership*, *12*(3), 306-321. https://doi.org/10.18666/JOREL-2020-V12-I3-10109

Garst, B., Scheider, I., & Baker, D. (2001). Outdoor adventure program participation impacts on adolescent self perception. *The Journal of Experiential Education, 24*(1), 41-49. https://doi.org/10.1177/105382590102400109

Han, J., Yin, H., & Wang, W. (2016). The effect of tertiary teachers' goal orientations for teaching on their commitment: The mediating role of teacher engagement. *Educational Psychology, 36*, 526-547. https://doi.org/10.1080/01443410.2015.1044943

Heinlein, A. G. (2018). *Experiential learning in the middle school living environment experiential learning in the middle school living environment classroom* [Master's thesis, SUNY Brockport].

Hossain, M., & Robinson, M. (2012). *How to motivate US students to pursue STEM (science, technology, engineering and mathematics) careers*. https://files.eric.ed.gov/fulltext/ED533548.pdf

Houge Mackenzie, S., & Hodge, K. (2019). Adventure recreation and subjective well-being: A conceptual framework. *Leisure Studies, 39*(1), 26-40. https://doi.org/10.1080/02614367.2019.1577478

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research, 15*(9), 1277-1288. https://doi.org/10.1177/1049732305276687

Ilker E., Musa, A. S., & Sunusi Alkassim, R. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics, 5*(1), 1. https://doi.org/10.11648/j.ajtas.20160501.11

James, J. K., & Williams, T. (2017). School-based experiential outdoor education: A neglected necessity. *Journal of Experiential Education, 40*(1), 58-71. https://doi.org/10.1177/1053825916676190

Janowicz, L. (2020). *Adolescent adventures in geology: Impact of geoscience-focused STEM education combined with recreation activities on adolescents perceived self-efficacy* [Unpublished master's thesis]. West Virginia University.

Jones, J. J., & Hinton, J. L. (2007). Study of self-efficacy in a freshman wilderness experience program: Measuring general versus specific gains. *Journal of Experiential Education, 29*(3), 382-385. https://doi.org/10.1177/105382590702900311

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development executive skills of family medicine faculty view project learning sustainability view project*. Prentice-Hall, Inc.

Lane, H. C., Cahill, C., Foutz, S., Auerbach, D., Noren, D., Lussenhop, C., & Swartout, W. (2013). The effects of a pedagogical agent for informal science education on learner behaviors and self-efficacy. In H. C. Lane, K. Yacef, J. Mostow, & P. Pavlik (Eds.), *Artificial intelligence in education* (pp. 309-318). Springer. https://doi.org/10.1007/978-3-642-39112-5_32

Larsen J., Minner, D., Rowe, E., Edwards, T., Asbell-Clarke, J., Bardar, E., & MacEachern, B. (2014). STEMLandia–The nature's apprentice geocaching adventure opening the door for STEM learning through outside games. In *Proceedings of the EdMedia: World Conference on Educational Media and Technology*.

Locklear, E. L. (2013). *4-H science initiative from inception to impact* [Unpublished report]. Noyce Foundation.

Mackenzie, S. H., Son, J. S., & Eitel, K. (2018). Using outdoor adventure to enhance intrinsic motivation and engagement in science and physical activity: An exploratory study. *Journal of Outdoor Recreation and Tourism, 21,* 76-86. https://doi.org/10.1016/j.jort.2018.01.008

Martin, K. (2018). Summer camp youth leadership development: An investigation of adolescents' perceptions of best practices. *Journal of Youth Development, 13*(1-2), 161-182. https://doi.org/10.5195/jyd.2018.536

Mayring, P. (2000). Qualitative content analysis. In U. Flick, E. von Kardorff, & I. Steinke (Eds.), *A companion to qualitative research.* SAGE.

McGeown, S. P., Putwain, D., Geijer-Simpson, E., Boffey, E., Markham, J., & Vince, A. (2014). Predictors of adolescents' academic motivation: Personality, self-efficacy and adolescents' characteristics. *Learning and Individual Differences, 32*, 278-286. https://doi.org/10.1016/j.lindif.2014.03.022

Mittelstaedt, R. D., & Jones, J. J. (2009). Outdoor recreation self-efficacy: Scale development and reliability. *Journal of Outdoor Recreation, Education, and Leadership, 1*(1), 97-120. https://doi.org/10.7768/1948-5123.1006

Mohr-Schroeder, M., Jackson, C., Miller, M., Walcott, B., Little, D. L., Speler, L., Schooler, W., & Schroeder, D. C. (2014). Developing middle school students' interests in stem via summer learning experiences: See blue stem camp. *School Science and Mathematics, 114*(6), 291-301. https://doi.org/10.1111/ssm.12079

Mutz, M., & Müller, J. (2016). Mental health benefits of outdoor adventures: Results from two pilot studies. *Journal of Adolescence, 49*, 105-114. https://doi.org/10.1016/j.adolescence.2016.03.009

National Research Council. (2009). *Learning science in informal environments: People, places, and pursuits.* The National Academies Press.

National Research Council. (2015). *Identifying and supporting productive STEM programs in out-of-school settings.* The National Academies Press.

Neuendorf, K. A. (2017). *The content analysis guidebook*. SAGE. https://doi.org/10.4135/9781071802878

Ngaka, W., Openjuru, G., & Mazur, R. E. (2012). Exploring formal and non-formal education practices for integrated and diverse learning environments in Uganda. *The International Journal of Diversity in Organizations, Communities, and Nations*, *11*(6). https://doi.org/10.18848/1447-9532/CGP/v11i06/39059

Passarelli, A., Hall, E., & Anderson, M. (2010). A strengths-based approach to outdoor and adventure education: Possibilities for personal growth. *Journal of Experiential Education, 33*(2), 120-135. https://doi.org/10.5193/jee33.2.120

Paxton, T., & McAvoy, L. (2000). *Social psychological benefits of a wilderness adventure program*. https://www.fs.usda.gov/research/treesearch/21988

Popovic, G., & Lederman, J. S. (2015). Implications of informal education experiences for mathematics teachers' ability to make connections beyond the formal classroom. *School Science and Mathematics, 115*(3), 129-140. https://doi.org/10.1111/ssm.12114

Rameriz II, S., Teten, S., Mamo, M., Speth, C., Kettler, T., & Sindelar, M. (2022). Student perceptions and performance in a traditional, flipped classroom, and online introductory soil science course, *Journal of Geoscience Education, 70*(1), 130-141. https://doi.org/10.1080/10899995.2021.1965419

Richmond, D., Sibthorp, J., Gookin, J., Annarella, S., & Ferri, S. (2018). Complementing classroom learning through outdoor adventure education: Out-of-school-time experiences that make a difference. *Journal of Adventure Education and Outdoor Learning, 18*(1), 36-52. https://doi.org/10.1080/14729679.2017.1324313

Roberts, T., Jackson, C., Mohr-Schroeder, M. J., Bush, S. B., Maiorca, C., Cavalcanti, M., Craig Schroeder, D., Delaney, A., Putnam, L., & Cremeans, C. (2018). Students' perceptions of STEM learning after participating in a summer informal learning experience. *International Journal of STEM Education, 5*, 35. https://doi.org/10.1186/s40594-018-0133-4

Rogoff, B., Callanan, M., Gutiérrez, K. D., & Erickson, F. (2016). The organization of informal learning. *Review of Research in Education, 40*(1), 356-401. https://doi.org/10.3102/0091732X16680994

Saldaña, J. (2013). *The coding manual for qualitative researchers*. SAGE.

Sasson, I. (2014). The role of informal science centers in science education: Attitudes, skills, and self-efficacy. *Journal of Technology and Science Education, 4*(3), 167. https://doi.org/10.3926/jotse.123

Schwartz, F., & Belknap, C. J. (2017). Effects of a college outdoor orientation program on trait emotional intelligence. *Journal of Outdoor Recreation, Education, and Leadership, 9*(1), 69-82. https://doi.org/10.18666-2017-V9-I1-7429

Shellman, A., & Ewert, A. (2010). A multi-method approach to understanding empowerment processes and outcomes of adventure education program experiences. *Journal of Experiential Education, 32*(3), 275-279. https://doi.org/10.1177/105382590903200310

Smith-Palmer, T., Schnepf, S., Sherman, A., Sullenger, K. S., & Macdonald, L. (2015). An exploration of summer science camps as an informal learning environment. In K. S. Sullenger, & R. S. Turner (Eds.), *New ground: Pushing the boundaries of studying informal learning in science, mathematics, and technology* (pp. 67-91). Sense Publishers. https://doi.org/10.1007/978-94-6300-022-2_4

Son, J. S., Mackenzie, S. H., Eitel, K., & Luvaas, E. (2017). Engaging youth in physical activity and STEM subjects through outdoor adventure education. *Journal of Outdoor and Environmental Education, 20*(2), 32-44. https://doi.org/10.1007/BF03401012

South Dakota School of Mines Geology Rocks! Summer Camp. (n. d.). *South Dakota School of Mines geology rocks! Summer camp*. https://www.sdsmt.edu/Academics/Events-and-Outreach/Summer-Camps/Camp--Geology-Rocks/

Stanchfield, J. (2016). *Tips & tools for the art of experiential group facilitation*. Wood N Barnes Publishing.

Toomey Zimmerman, H., & Bell, P. (2012). Everyday expertise: Learning within and across formal and informal settings. In D. Jonassen, & S. Land (Eds.), *Theoretical foundations of learning environments* (pp. 224-241) Routledge.

Widmer, M. A., Taniguchi, S. T., & Duerden, M. D. (2014). Increasing and generalizing self-efficacy: The effects of adventure recreation on the academic efficacy of early adolescents. *Journal of Leisure Research Copyright, 42*(2), 165-183. https://doi.org/10.1080/00222216.2014.11950318

Wilson, C., Akiva, T., Sibthorp, J., & Browne, L. P. (2019). Fostering distinct and transferable learning via summer camp. *Children and Youth Services Review, 98*, 269-277. https://doi.org/10.1016/j.childyouth.2019.01.017

Yeh, Y., Chen, S.-Y., Rega, E. M., & Lin, C.-S. (2019). Mindful learning experience facilitates mastery experience through heightened flow and self-efficacy in game-based creativity learning. *Frontiers in Psychology, 10*, 1593. https://doi.org/10.3389/fpsyg.2019.01593

Yilmaz, M., Ren, J., Ramirez, D., Custer, S., & Coleman, J. (2010). An improved K-12 outreach camp for engineering disciplines. In *Proceedings of the 2010 Annual Conference & Exposition*. https://doi.org/10.18260/1-2--16516

Zimmerman, B. J., & Cleary, T. J. (2006). Adolescents' development of personal agency: The role of self-efficacy beliefs and self-regulatory skill. In F. Pajares, & T. Urdan (Eds.), *Self-efficacy beliefs of adolescents* (pp. 45-70). Information Age Publishing.

APPENDIX A: CODING STRUCTURE

Table A1. Self-efficacy parent & child codes with definitions

Parent codes with definitions	Child codes	Child code definitions
Mastery/non-mastery experience: Attempts to overcome obstacles through perseverant effort followed by successes or failures.	Sense of accomplishment	Feeling(s of) achievement after having participated in an activity or having new thoughts about self
	Sense of failure	Feeling that one missed to meet expectations or accomplish certain tasks. Expression of a lack of success, often accompanied with negative feelings
	Perseverance	Overcoming or attempting to overcome an obstacle(s) through continued effort or through "stepping out of one's comfort zone."
	Avoidance	Attempting to refrain from participating in certain activities or tasks. Sometimes due to fears of leaving "comfort zone."
	Quitting	Completely stopping a task
Enjoyment: Whether someone does or does not enjoy something.	-	-
OR interest: Whether or not a participant is interested in OR activities or makes any mention of their interest in OR in general.	-	-
Perceived challenge: Whether or not one feels personally stimulated by a task or problem. How one feels about a task that may need great mental or physical effort to be done successfully.	-	
Social influence: Taking a specific action on or having specific thoughts & feelings about SE because of social standards &/or direct & indirect influence of peers.	-	-
Motivation to participate (in OR activities): Extent to which one desires to take part in an activity & why.	-	-
Physiological & emotional state: Mood (e.g., happy, sad, or excited). Thoughts about physical functioning of body (e.g., feeling tired or fatigued).	-	-
Vicarious experience: Seeing people similar to oneself succeed by sustained effort; thus, raising observers' beliefs that they too possess capabilities to succeed in a similar situation.	-	-
Perceived coping abilities/skills: How one feels about their capabilities in dealing with high pressure or stressful situations. Expression of belief that they do or do not have skills or expression of specific skills they feel they have that can help them accomplish tasks in these high pressure situations.	-	-
Expectations: How one thinks that a certain event will go or how they believe they will react in a certain situation.	-	-
Exercise self-influence: Action or perceived ability to enact an action.	-	-
Previous experience: Previous experiences one has (or lack thereof) that may lead to higher (or lower) self-efficacy related to those experiences.	-	-
Perceived safety/risk: Extent to which someone feels they are exposed to danger or extent to which they feel opposite.	-	-
Perceived OR knowledge/skills: Perceived levels of OR-related knowledge &/or skills.	-	-
Perceived mental state: One's feelings about one's state of mind or mental condition at any given time.	Calmness	
	Perceived control over mental state	
Confidence: Expression of a feelings about certainty of abilities or self-reliance.	Increase in self-reported confidence	Self-reporting of growth in levels of confidence or feelings related to confidence after participating in intervention.
	Decrease in self-reported confidence	Self-reporting of reduction in levels of confidence or feelings related to confidence after participating in intervention.