Impacts of Facilitating Invention Education on Teachers' School Year Practices

A Technical Report prepared for Camp Invention®

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January 25th 2022

Executive Summary

Camp Invention® provides out-of-school time summer enrichment programs for K-12 students with the aim of both strengthening and diversifying the domestic STEM and invention pipeline. Camp experiences are typically facilitated by classroom teachers who subsequently return to formal classroom settings during the school year. This study investigated the various motivations of facilitators, the aspects of the experience that they found most meaningful and memorable, and their perceptions of what could be transferred from the camp context to the formal classroom. The findings inform our understanding of the transfer of invention education strategies from out-of-school time to formal school time settings, as well as the factors that might facilitate or impede this process. The study addressed four research questions: RQ1. What beliefs, self-perceptions, goals, and possibilities for action drive teachers' decision to facilitate a week-long invention education program for elementary and middle school students? RQ2. To what extent do participating teachers view themselves as being inventive and innovative? RQ3. During the week-long invention education program, which experiences are most meaningful for teachers? RQ4. During the school year, to what extent do participating teachers draw from their experiences facilitating Camp Invention programs when planning and teaching in their regular assignment?

Data were collected in three waves (n=85, n=137, n=119) during summer and fall of 2021. Surveys included demographic information as well as modified versions of the *Inventive Mindset* measure (Garner, Matheny, Rutledge & Kuhn, 2021). Descriptive and inferential statistics were used to analyze quantitative data and the Dynamic Systems Model of Role Identity (DSMRI; Kaplan & Garner, 2017) was used as a framework for analyzing the qualitative data.

In brief, the study revealed that individuals' perceived themselves to be more inventive as a teacher than in everyday life. Their professional goals and beliefs in the role of teacher were salient motivating factors behind their decision to become a facilitator, along with beliefs in the efficacy of the Camp Invention® curriculum. The most meaningful moments for facilitators were also capitulated through the role of teacher and coalesced around changes in camp participants' inventiveness or self-confidence. The facilitation experience influenced both the pedagogical approaches and the specific activities planned for use in the school year classroom. By the end of the first quarter, many respondents described having implemented either a pedagogical approach such as problem solving or hands-on learning, or one or more components of a camp activity or challenge. Teachers expressed a desire to bring additional Camp Invention® aligned pedagogical approaches into their classrooms, including invention skills, experimenting, and exploring. However, respondents were mindful of constraints including a lack of resources and a perceived incongruence with their required curriculum. We recommend that Camp Invention® may, if seeking to promote overlap between summer and school year invention education experiences for K-12 students, explore ways to support teachers who serve as facilitators as many of them expressed a desire to transfer invention education pedagogy into their classroom.

Introduction

Camp Invention® provides out-of-school time summer enrichment programs for K-12 students with the aim of both strengthening and diversifying the domestic STEM and invention pipeline. The camp experiences are typically facilitated by classroom teachers who subsequently return to formal classroom settings during the school year. As part of ongoing efforts to examine the impact of Camp Invention® on its participants and stakeholders, this study investigated the various motivations of facilitators, the aspects of the experience that they found most meaningful and memorable, and their perceptions of what could be transferred from the camp context to the formal classroom.

Significance

Each year, a large number of schools, universities, and non-profit organizations engage in formal and non-formal methods to strengthen and diversify the STEM and invention pipeline. Many of these methods, whether in the form of classroom lessons, after school clubs, or summer enrichment experiences, deploy K-12 teachers as facilitators of students' learning. Because teachers represent the point of delivery, it is important to understand their beliefs, attitudes, and motives towards invention education programming. Since relatively little is known about this topic, we turn to existing literature that has demonstrated links between teachers' conceptualizations of their role and their intentions towards practice. Insights into teachers' experiences may guide efforts to increase the impact of Camp Invention® programming and identify ways to infuse invention education into the formal K-12 curriculum.

Theoretical Framework

Teachers accrue a variety of professional experiences over the course of their careers, and many draw on past experience when planning lessons and activities for students. A growing body of literature suggests that teachers' decision making arises is rooted in their conceptualization of their role as a teacher. Specifically, actions arise from an interplay among teachers' role identity components of ontological and epistemological beliefs, purposes and goals, self-perceptions and self-definitions, and action possibilities in a given social context (Garner & Kaplan, 2018). Preferred (and sustained) actions in the role of teacher tend to arise from an alignment of these components and their social context. Similarly, new experiences tend to be viewed through the contents of existing identity commitments to particular beliefs, goals, and courses of action that are embedded within the overall conceptualization of the teacher role.

These principles of role identity structure and process are depicted in the Dynamic Systems Model of Role Identity (DSMRI; Kaplan & Garner, 2017), a meta-theoretical framework for analyzing learning, motivation, and decision making in a particular role. The model is shown in Figure 1.

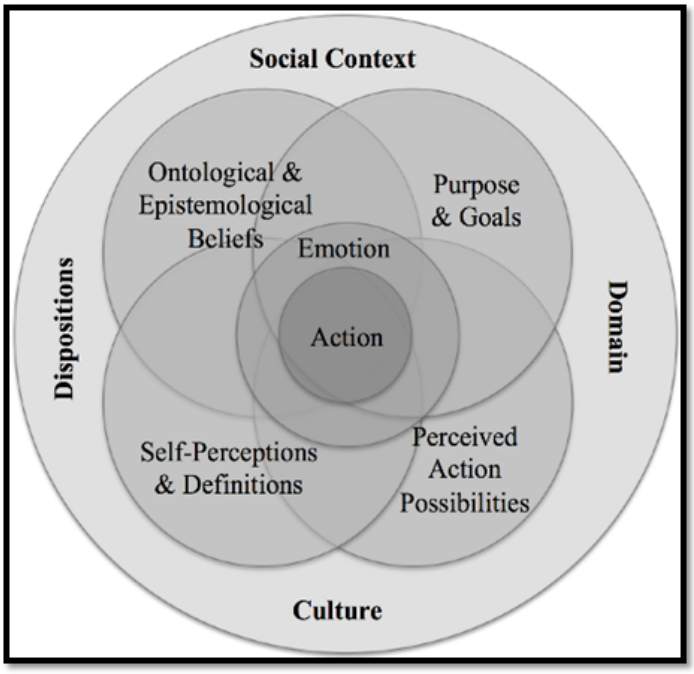

Figure 1. The Dynamic Systems Model of Role Identity (Kaplan & Garner, 2017).

The innermost circle of the DSMRI represents action in a particular social role such as teacher. Acting in this role is associated with emotions and thoughts that are congruent to varying degrees with self-perceptions and self-definitions a person attributes to themselves, beliefs about the nature of the world and its inhabitants as these pertain to the role, purposes and goals for acting in a role or inhabiting a role, and perceptions about what is and is not feasible to do in that role. All are situated within influential background parameters: a social and cultural context in which the role is enacted, the nature of the domain for which the role is distinct (e.g. science teaching, medicine), and the enduring dispositions of the individual who is inhabiting and constructing the role. The DSMRI proposes that identity systems have a fractal, dynamic, and hierarchical structure, meaning that individuals can possess multiple social role identities (e.g. teacher, facilitator, administrator, parent) that can influence one another over time.

Research using the DSMRI has found that teachers' perceptions of specific experiences is grounded in their identity as a teacher, and that their reflections on these experiences influence subsequent actions in that role (Garner & Kaplan, 2018; Hathcock, Garner, & Kaplan, 2020). When the DSMRI is applied to the context of teachers who are becoming Camp Invention® facilitators, it is reasonable to propose that motivation to participate would be grounded in existing self-perceptions, beliefs, goals, and action possibilities in the role of teacher. Moreover, because the role identity system acts as an intra-individual mechanism for interpreting and making meaning from experiences, it is also possible that the contents of some of the role components or the experiences of Camp Invention® facilitators are absorbed into the role of

classroom teacher. The camp facilitation role therefore has the potential to influence the ways in which classroom teachers approach teaching and learning as it pertains to STEM and invention. We investigate this proposition using the DSMRI, which can be used as an analytical and interpretive framework for gathering data about facilitators' role identities within the Camp Invention® social context and their subsequent re-entry as teachers into the classroom. This will inform our knowledge about transfer of invention education strategies from out-of-school time to formal school time settings, as well as the factors that might facilitate or impede this process.

Research Questions

This research was undertaken to gain a deeper understanding of the ways in which Camp Invention® facilitators conceive of their role and how it intersects with their existing (and subsequent) role as a classroom teacher. With this aim in mind, we articulated four research questions:

> RQ1. What beliefs, self-perceptions, goals, and possibilities for action drive teachers' decision to facilitate a week-long invention education program for elementary and middle school students?
>
> RQ2. To what extent do participating teachers view themselves as being inventive and innovative?
>
> RQ3. During the week-long invention education program, which experiences are most meaningful for teachers?
>
> RQ4. During the school year, to what extent do participating teachers draw from their experiences facilitating Camp Invention programs when planning and teaching in their regular assignment?

Methods

Participants. The participants were Camp Invention® facilitators who were providing face-to-face or online programming during the summer of 2021. Participants varied across the three waves of data collection, as described below.

Procedure. Following approval by Old Dominion University Institutional Review Board, Camp Invention® staff distributed email invitations to participate in each wave of the study. In the first phase, participants were invited to complete a survey shortly after summer programming had taken place. A total of 85 facilitators responded to this initial invitation. In this sample, most (89%) were female. Most (87%) identified as White, with 5% identifying as Black or African

American, 6% identifying as Two or more races, 1% identifying as Asian, and 1% identifying as Hispanic or Latino. The sample had an average of 16 years of teaching experience. In the second phase, participants were invited to complete a survey shortly after the beginning of the school year. A total of 137 facilitators responded to this invitation. Demographic information was not gathered in this wave. In the third phase, participants were invited to complete a survey at the end of the first trimester or marking period of the school year. A total of 119 participants responded to the final survey invitation. The majority of these participants were White (92.4%). A small percentage identified as Black or African American (2.5%), Hispanic or Latino (2.5%) or Two or more races (2.5%). The majority of the sample was female (89.9%) and had an average of 17 years of teaching experience.

Data analysis. Data were gathered using the Qualtrics online survey tool, then downloaded and analyzed by the researchers using SPSS and Excel software. When completing the pre-camp survey, participants were instructed to create a unique identifier for themselves and then use this each time they completed a survey. However, many more unique participants than repeat participants completed the survey each time, which meant that a relatively small number of cases was available for analysis over time.

Quantitative data. Survey data included quantitative responses to demographic questions and a modified version of the ten-item *Inventive Mindset* measure (Garner, Matheny, Rutledge, & Kuhn, 2021). Descriptive statistics for each administration ("In everyday life…" "As a teacher…") were generated using total scores. Likert scale *Inventive Mindset* items are as follows: I am open to new ideas; I do not give up easily; I am a problem solver; I like to design things; I have lots of good ideas; I am imaginative; I life to share my ideas with others; I am creative; I like to make things better; I am inventive.

Qualitative data. A combination of inductive (bottom-up) and deductive (top-down) qualitative analysis methods (Zhang & Wildemuth, 2009) was used to analyze participants' written responses to open-ended survey items. Responses were analyzed thematically by question/prompt, using a method that involved primary review by one researcher followed by an audit, or secondary review, by the second researcher. Deductive analyses were conducted in accordance with the DSMRI Manual and Codebook (Kaplan & Garner, n.d.). DSMRI role identity components are highlighted in italics as they appear in the following section. Deductive analyses were conducted by the primary researcher. Preliminary themes and findings were discussed with Camp Invention® staff ahead of the preparation of this final report. In the following section, the three most prevalent themes under each topic or question are presented along with illustrative examples.

Findings

RQ1. What beliefs, self-perceptions, goals, and possibilities for action drive teachers' decision to facilitate a week-long invention education program for elementary and middle school students?

To answer this question, we asked participants to "write a paragraph explaining why you decided to facilitate invention education programming through Camp Invention." The resulting 118 responses were analyzed thematically and with the DSMRI model to obtain insights into the content and alignment between participants' beliefs, self-perceptions, goals, and action possibilities. Below, we present the findings by theme with pertinent DSMRI components in selected representative responses.

Theme 1. Teachers participate to gain experience or enjoyment in the role of facilitator.

Participants were motivated by *goals* that aligned with their *self-perceptions* in the role of teacher and their *beliefs* about the facilitator role. One participant expressed the *self-perception* of being a relatively novice teacher with a goal of gaining experience and wrote,

> "I decided to facilitate camp invention because I am an upcoming teacher in the next year and this will be good experience for me."

Another respondent who had participated in multiple years of facilitation commented on their initial *goals* for participating and revealed additional goals for continuing to participate. This individual also implicitly contrasted their *action possibilities* in the role of school-year teacher with the role of facilitator, and expressed positive emotions about the subject matter (science) in the social context of the camp. They wrote,

> "I chose to become an instructor for Camp Invention to deepen my knowledge and ability to create engaging science lessons. I continued to participate in Camp Invention because I discovered it was also an opportunity for me to remember the true excitement of teaching—without the trappings of standard school year teaching (no meetings, grading, and data analysis). This week in summer is a moment to share the joy of science with students and myself."

Some participants explicitly mentioned learning *goals* for themselves. One wrote, "I thought it would be a good learning experience for me as an educator. I am hoping to learn more about implementing STEM into my classroom during the school year."

Theme 2. Teachers participate in order to provide a meaningful experience for Camp participants.

Multiple responses emphasized facilitators' *beliefs* about the nature of the camp experience for students, which included references to the content of the camp as well as the ways in which the camp curriculum affords opportunities that are otherwise not available in formal educational contexts. One respondent wrote,

> "Camp Invention provides hands-on learning experiences, critical thinking and self-direction that are not always present in a typical classroom. Having taught 39 years in grades K-8th, I see a real need to provide this type of education for children of all ethnic and societal groups. Our students are not learning how to use their critical thinking skills as much as they should."

Another, thematically similar response elaborated on the features of the *social context* of the camp that are believed to be of value for students, saying:

> "Camp Invention allows for the freedom of creativity and imagination to be expressed and grow through original thought and action. Students are able to experience the process of critical thought in a relaxed environment without anxiety or fear of testing or evaluation; no comparison to others based on a numbered score, but a more valuable experience of expression of individual ideas and choice."

In some cases, responses reflected an alignment of *self-perceptions* and *beliefs*. For example, a participant wrote that they "enjoy working with children and value the skill of inquiry. Problem solving is critical for their advanced grades."

Theme 3. Facilitators mentioned the quality or reputation of Camp Invention.

Multiple respondents wrote positive comments about the quality of Camp Invention® experiences for students. One wrote, "Everything is provided to the team with everything very well laid out. The curriculum is outstanding and very engaging for the students," while another wrote "It is a well-thought out program that is easy to teach and administer." Statements such as these reveal how impressed the facilitators were with ready-made *action possibilities,* and how these aligned with their *beliefs* about the benefits for students. As one respondent wrote,

> "…as a HS sciences teacher, I didn't really want to work with young kids who I don't know over the computer. I was blown away with how organized and engaging the materials were. It was fantastic that, as someone who just jumped on board at the last minute, I was able to be confident in how to facilitate the kids' learning. The curriculum

> and script gave me enough of a start to take it and run. The kids had a great time and so did I! I felt it was the best STEM program that I had ever seen for that age group and I wanted to bring it to my own school district."

Theme 4. Participation due to an alignment of multiple sources of motivation.

A number of respondents mentioned multiple sources of motivation for participating as a facilitator. In some cases, these responses provide further insights than those already presented. For example, one respondent mentioned professional growth as a teacher, a financial incentive, and the opportunity to meet students in their response:

> "I was asked by a colleague to be an instructor for Camp Invention. I thought it would be a good experience for me as I am still pretty new to teaching. I wanted to participate in the camp as a learning and growing opportunity for myself. It is also a way for me to make money during the summer and also connect with students I already know and meet new students."

Another respondent also illustrated how multiple sources of motivation influence the decision to participate:

> "I decided to facilitate invention education for several reasons. First, Camp Invention offers a nice stipend, which I can use to help my family and to support my salary. Second, I want to learn more about STEAM education; since I primarily teach English, I would like to find new ways to incorporate STEAM into my work. Finally, I like giving students the opportunity to explore and to be creative with what they have around them so that they can learn to [be] resourceful."

Summary. Components of facilitators' roles as teachers were likely to be evoked when describing the decision to participate in Camp Invention. Responses revealed goals of gaining confidence, experience, and specific strategies that could be transferred to the classroom. Often, such goals co-existed with the desire to work with students in an environment that has fewer constraints for teachers and students than a formal classroom setting.

RQ2. To what extent do participating teachers view themselves as being inventive and innovative?

Whereas the Camp Invention® curriculum is designed to spur students' inventiveness, creative thinking, and problem solving, little is known about facilitators' own perceptions of themselves as being inventive and innovative. We were interested in the degree to which facilitators saw themselves in this way, and hypothesized that there might be a difference in self-

perceptions based on "everyday life" versus when being a teacher. Generally, participants saw themselves as being quite inventive, but rated themselves higher when responding "as a teacher." The following table presents the data from two waves of data collection. Note that the maximum possible score on the *Inventive Mindset* Questionnaire is 60.

Table 1. The inventive mindset scores of two samples of Camp Invention facilitators.

	Pre-Camp Sample (n=129)		Post-Camp Sample (n=138)	
	Mean	Std. Dev.	Mean	Std. Dev.
Everyday life	50.60	7.11	50.11	6.15
As a teacher	53.27	6.40	52.87	5.36

The difference between the two sets of ratings ("as a teacher" versus "everyday life") was statistically significant for those who completed the survey ahead of facilitating at Camp Invention, $t(128) = -7.28$, $p<0.000$ and for those who completed the survey after facilitating at Camp Invention, $t(137) = -7.82$, $p<0.000$. *Respondents rated themselves as being more inventive and innovative in the role of teacher than in everyday life.*

A small number of participants (n=19) completed the survey at both time points. From these participants' total pre- and post-camp scores, which were not statistically significantly different, we conclude that facilitating Camp Invention® in its current form is unlikely to have had an impact on facilitators' perceptions of themselves as being inventive and innovative. However, the small number of matched cases means that this conclusion should be treated as tentative and subject to further study.

RQ3. During the week-long invention education program, which experiences are most meaningful for teachers?

We asked participants to "choose a meaningful or memorable moment or activity that happened" while during the camp, and to describe the event and why it was meaningful or memorable. By framing the question in this way we hoped to gain insights into the ways in which the experiences solicited satisfaction, surprise, or emotions that often co-occur with change. The analysis therefore proceeded thematically but special emphasis was placed on identifying emotions. As we have done previously we present three illustrative quotes rather than an exhaustive list of coded comments.

Theme 1. Witnessing student growth

A number of responses referenced changes that were witnessed in the students. Changes typically pertained to confidence. One respondent commented on the way a student communicated her inventive ideas with others for the first time during the camp:

> "During Camp this year, I witnessed to [sic] blossoming of an inventor. A third grade girl who has never been communicative about her ideas, designed a crown of feathers for the design an article of clothing day. She proudly explained that her feathers came from chicks that her class raised during the school year, and she took home for the summer. I have never seen this girl so animated as she shared her inventive ideas for the crown."

Another facilitator wrote about witnessing a change in a young student:

> When one of the kindergarten students who was more immature in their social develop successful built a prototype and was able to be one of the first to come up with a creative pitch for the open mic model. In that week there was a lot of growth for this young man in the social-emotional area.

Both of these comments describe how the invention challenges seemed to act as a catalyst for the student's gains in confidence to share their ideas.

Several respondents recounted interactions they had with the students during the course of the camp. One remarked on their own role in facilitating a change from frustration to confidence in a student, writing:

> "While inventing landmarks, a child was getting frustrated with the quality of his Sydney Opera House. He wanted very realistic-looking "sails" for the top and it wasn't working out for him. I asked him "what do you feel you are missing?" and he said, "the OOMPH!" which made me smile- he asked why I was smiling and I said "The "oomph" you're looking for is the fact that you made a postal box into the Sydney Opera House. I look at that and I SEE it. You put your heart into it. It is good!" His face lit up and you could see that he was worried that it wasn't good enough, and hearing that it was from another person was all he needed. He didn't need ideas or suggestions, he just needed validation. Sometimes, that's all inventors need."

Theme 2. Witnessing student learning and problem solving

A second theme emerged from respondents who described meaningful and memorable moments that involved witnessing students' learning and problem solving. One wrote,

> "I had a student who was trying to get their SolarBot across the puddle. He created a pulley system that was anchored in the ceiling and it was definitely the most inventive method of getting the SolarBot."

Another respondent described how it was memorable to hear a student recount their design project, saying:

> "An at home project was to design a costume. One boy put lots of work into the design and wore it to school the next day. He explained how he made it, what he used, and how he had to try different items before it would actually work."

Some responses included a description of the event, details about an interaction, and explicit description of the emotions experienced by the facilitator during the memorable moment. For example, one facilitator wrote:

> "A memorable moment I experienced was during Road rally. I had a student come up to me frustrated that their car engine was not working. I said let's think about this a different way! As soon as I gave the student this prompt he exclaimed let me go back to the propellor method! And went to his desk to work on this issue. He solved his problem and I was his guide mentoring him through the process. I was proud and excited."

Theme 3. Experiencing pedagogical growth as a teacher/facilitator

A third theme that emerged in response to the question about relaying a memorable or meaningful moment was that of experiencing growth as a professional. Typical responses in this category reflected a description of an event that led to the need for new action possibilities in the role of facilitator. For example, one facilitator wrote a long description of an event, abridged as follows:

> "During the final day of Camp, the kids were expected to pitch their inventions to the rest of the class. I ideally wanted each student to make their own pitch, since they were the creators of their invention, but in my mind I would let the students choose a leader or LIT if they were too nervous...With the first group, I didn't mention the latter part at first, hoping to save it to only if needed. However, after the first few students went, and did it quietly with their microphone and didn't provide much info, a few students refused to present. I was surprised, given that all the students who refused had put in a lot of time and effort into their inventions…In total I believe I had 4 total refusals in the first class, and the ones who went were very subdued and difficult to hear. It was extremely deflating, but I knew I had to adapt before the second group to repeat any issues. The first change I made was offering up the alternative pitch before any students even went. Then, in all the later groups I started with a student who I knew would either be comfortable and confident by themselves…the students seemed much more comfortable knowing they didn't have to do it alone if they were uncomfortable. However, I did make the student stand next to their presenter to give the experience of being up in front of the class, and in the other classes I was less inclined to just let a student not go at all. The last 3 classes each went much better than the first, and I was surprised and impressed with many of the students' abilities to make a pitch, as well as the enjoyment they got out of the "adults" pitching the inventions."

Another respondent wrote that an experience reminded them of prioritizing the students' needs in order to press on with the camp goals. The respondent wrote,

> "Our area was subject to a tornado warning and the kids shared their experiences in a sharing circle before we began our sessions. I don't usually teach younger children, and it reminded me that so many experiences are new for these young students, and processing stressful events are an essential gateway to accessing their creativity. Glad we took the time to address what was on their minds, making it easier for them to put those thoughts aside."

Summary. Generally, the most meaningful events for facilitators involved moments when students changed their demeanor or behavior in ways that reflected the overall goals of the camp, or demonstrated new skills with the assistance of the facilitator or others present. Very few facilitators wrote solely about their own growth or their own emotions, suggesting that the students remained at the center of the facilitators' attention throughout the camp.

RQ4. During the school year, to what extent do participating teachers draw from their experiences facilitating Camp Invention programs when planning and teaching in their regular assignment?

The final research question was intended to ascertain the degree to which facilitators, most of whom were also classroom teachers, were able to draw on their Camp Invention® experiences when returning to the classroom. We divided this question into two subparts. The first part asked whether facilitators did draw on their experiences, and the second asked about what, in an ideal world, facilitators would take to the classroom.

What did facilitators transfer to the classroom?

A total of 119 facilitators responded to this phase of the school year survey. Of these, 107 reported that they were currently teaching in a school setting, with the most common grade levels being grades 2 and 5, reflecting 10.5% and 12.4% of the sample respectively. Fourteen participants did not respond to the specific question about having drawn on their facilitation experiences, and 24 participants indicated that they had not done so. This left 81 responses that were coded inductively into themes pertaining to what had been transferred from the camp setting to the classroom: use of activities or activity components; influence on pedagogy, including STEM pedagogy; and sharing strategies, information, and resources with colleagues. A small number of comments (n=2) did not align with these themes and are not discussed. The coding scheme was applied in a non-exclusive manner, meaning that a response could align with more than one theme.

Theme 1. New action possibilities: use of an activity or activity components

Thirteen of the responses referred to using an activity or components of an activity. For example, one teacher responded "Yes, we made musical instruments out of recycled products" and another wrote "Yes, I have talked about patents and the design engineering process." Thematic influences were also apparent: one teacher wrote "I have done more STEAM activities with my students this school year."

Theme 2. Influence on goals: general and STEM pedagogy

A second theme was the influence on pedagogy. Forty-two (52%) of teachers' responses referred to a shift in their goals and in their approach to learning. For example, several teachers wrote about using more hands-on learning either in general or in science or STEM subjects. One stated "I am trying to provide hands-on experiences" and another stated that they are using "more hands-on STEM challenges and activities that require students to be more innovative and creative in their approaches." Similarly, a teacher wrote "Having switched to science only this year, the way Camp Invention is set up is perfect for what I want to do in my classroom."

The use of more open-ended, exploratory, and inquiry-based activities was also prevalent within this theme. A teacher wrote "I have incorporated more engineering/designing experiences and embraced the idea of prototypes and learning from failures" and another stated "I have chosen to allow my students to investigate and inquire before providing them with steps." This idea was echoed in other responses such as "Allow children to be more free thinking and explore using their own minds without exact directions."

Broader influences on pedagogy were also apparent in the responses. One individual wrote, "I use my camp Invention experience every year in different ways. Whether it be grouping kids, giving "hints" as I see students struggling with a STEM activity, pushing thinking further, or simply by allowing for different methods and explanations on how to solve problems." Another focused on the skills they had learned as a facilitator, saying "Having to teach multiple grade levels in Camp Invention with the same activity, I think this helped me in the school year by being able to easily adapt lessons and activities for students of varying grade levels."

Some of the responses represented a blend of the first two themes. Ten responses clearly incorporated specific activities or activity components from Camp Invention® as well as referring to influences on their general pedagogical approach. For example, one respondent stated, "I used the car building in my force and motion class and duck chuck in my after-school club again about force. I think it helped me also think more outside the box as a teacher." Another respondent commented, "Using hands-on STEM activities in science: design and build a bridge to hold the 3 Billy Goats Gruff; design and build a house that would withstand the Big Bad Wolf. Cooperative learning experiences with partners and small groups." Other respondents connected STEM with general pedagogy, writing that they were "incorporating STEM into my classroom and the inquiry approach to learning" and "conducting more experiments and hands-on activities in class. Allowing students to explore STEM with topics of interest."

Theme 3. Influence on the role of colleague: sharing of ideas with others

The third theme that emerged reflected teachers' sharing of ideas with other colleagues and in other settings. Four respondents stated that they work with other educators. One, in their role of instructional coach, wrote that "I have shared the experiences I had with Camp Invention with teachers throughout the district" and another commented that they are "helping the educators I am working with incorporate creativity and STEM into their classrooms." Another teacher responded that "I have shared with many of the teachers in my district the skills and things I learned by facilitating this summer!" This respondent then stated, "I have encouraged them to apply to be a facilitator next year."

What, in an ideal world, would facilitators transfer to the classroom?

Three additional themes emerged from coding the 107 responses to the question of what, ideally, they would bring to the classroom: transfer of an activity or activity components; transfer of hands-on learning opportunities; and transfer of invention skills and pedagogy. As before, codes were applied in a non-exclusive manner, because in some cases respondents listed multiple ideas that pertained to more than one theme.

Theme 1. Transfer of invention skills and invention pedagogy

By far the most frequent idea for transfer was for invention skills and aspects of pedagogy that support those skills. Fifty statements (47%) included explicit attention to this, and ten additional responses connected this theme to the theme of hands-on learning. Within this large group of statements, common terms used included "problem solving" which was mentioned 7 times, "invent," "inventive," or "inventing" which was mentioned 10 times, and derivations of "creative" or "create" which were mentioned 24 times. Other common terms included "experiment" or "experimenting" which was mentioned 9 times, "design" which was mentioned 7 times, and "explore" or "exploration" which was mentioned 11 times. Respondents clearly identified invention pedagogy components in the Camp activities and expressed a desire to bring these components into their regular teaching contexts.

Theme 2. Transfer of hands-on learning opportunities

Fourteen respondents specifically highlighted that they would like to transfer the hands-on learning that took place at Camp Invention®. Responses included "All the hands on activities," "The hands-on experiences" and "Hands on learning." Some respondents provided reasons pertaining to student learning or classroom constraints, saying "The hands on learning because the kids love to create" and "More hands-on learning. It is difficult to do that when reading novels."

Six respondents combined these two ideas in their answer to the question. For example, one teacher reported "I did the solar cards during camp invention and that would be great to do with my regular students. Kids learn quite a bit with the hands on" and another stated "I facilitated the open mic and I believe most of the kids enjoyed it because it was [a] hands on type of learning experience." In one case, the teacher acknowledged a desire for the materials and the

lack of them in their teaching context, saying “The supplies! These students LOVE the hands on activities and it is difficult to purchase the items needed.”

Theme 3. Transfer of an activity or activity components

Eight respondents referred to a desire to transfer specific activities or components of activities, including those that align with STEM. One teacher stated, “I would like to use the activities used for Camp in the classroom.” Other respondents made specific references to particular activities. For example, a teacher commented, “They liked creating a way for the bots to get over the lake” and another stated, “The games!”

Summary. When given the opportunity to reflect, many facilitators expressed ways in which Camp Invention® pedagogy was, or could, be transferred into their school year classroom setting. Most commonly, respondents spoke about their goals and approaches to learning, which highlighted the transfer of hands-on, inquiry based, or problem-based activities found in the camp curriculum. Respondents often gave examples of specific “STEM” activities they had done in the camp setting and how they had modified or drawn upon these in their classrooms. Camp Invention® facilitation also seemed to spill over into respondents’ roles as colleagues. Several individuals described sharing ideas with colleagues as a result of participating as a facilitator.

When asked about “ideal” ways in which Camp Invention® might transfer to the classroom, respondents indicated a desire to teach invention skills and invention pedagogy, a desire to increase the amount of hands-on learning, and a desire to use specific activities that were included in the camp program. However, respondents also mentioned constraints, such as having to follow a curriculum that does not emphasize problem solving, or having insufficient funds to purchase materials.

Discussion

This research was conducted in order to investigate Camp Invention® facilitators’ motivations for participating in summer programming, to gain insights into the most memorable or meaningful aspects of their time as a facilitator, and to understand how they leveraged (or wanted to leverage) these experiences during the school year. As a frame for the study, we draw on existing literature and a metatheoretical model that acknowledge the dynamic relations between teachers’ classroom experiences and their formal or informal learning, service, or outreach experiences that typically take place during the summer, and the role of meaning making in professionals’ continuity and change of practice. However, we are equally interested in teachers’ perceptions of whether they are able to infuse the invention education pedagogies experienced during the summer in their formal classroom settings.

Respondents’ motivations to participate as Camp Invention® facilitators were very closely tied to their existing role identities as classroom teachers. Many of the facilitators were motivated by the possibility of gaining new ideas for their classroom, and were keen to actualize

students' learning and excitement towards STEM and invention. They held the camp in high regard, and believed that it would be a valuable experience for them as an educator.

Facilitators' role identities as teachers continued to be salient after they had completed their camp experience. The most meaningful and memorable events were likely to revolve around students' discoveries and breakthroughs rather than their own. Specific activities were included in respondents' descriptions of memorable events, suggesting that the camp curriculum creates positive and memorable experiences for facilitators as well as for students. The facilitators were generally very impressed with the camp activities and format and expressed a desire to draw on them as they returned to the classroom.

When facilitators stepped into the role of classroom teacher once again, particular features of Camp Invention® remained at the forefront of their minds. This was manifest in their articulated goals for students during the upcoming school year, which included using hands-on or problem-based learning opportunities. These goals were often aligned with action possibilities associated with particular challenges or lessons. Teachers were more likely to use the term STEM or science than invention when describing what they had transferred, and we did not find evidence that teachers were able to transfer the aspects of Camp Invention® pedagogy that are specific to invention (e.g. pitching ideas). However, when responding to the question about what they would do "in an ideal world," some expressed the desire to incorporate invention or inventiveness. Teachers did list specific challenges and limitations to transferring their experiences, including the expense of materials, a lack of materials, and the perceived rigidity of the curriculum.

Teachers' beliefs about their own inventiveness is a notably understudied topic. In this study, respondents were found to have self-perceptions of inventive traits or habits of mind, and were more likely to rate themselves as being inventive when in the role of teacher than in everyday life. Although this finding is tentative due to a small and self-selected sample, it suggests that there may be room to capitalize on teachers' perceptions of themselves as inventive in ways that can support their modeling of inventive habits of mind for their students, both in the summer and during the school year.

Recommendations

The following recommendations are intended to build on this line of inquiry, and carry the assumption that Camp Invention® leaders are interested in the transfer of its programming and pedagogical approaches into K-12 classrooms.

1. Consider developing camp preparation materials that leverage facilitators' self-perceptions and experiences of inventiveness;
2. Consider strategies to help facilitators who are interested in transferring pedagogies and activities to their own or their colleagues' K-12 classrooms;

3. Consider increasing facilitators' capacity to implement invention-specific activities such as problem finding, prototyping, or pitching ideas, in ways that complement the required curriculum.

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