Exploring the Impact of Systems Engineering Projects on STEM Engagement and Learning

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***Abstract*—Systems engineering is the interdisciplinary process of managing and executing complex engineering projects. As K-12 education increasingly emphasizes STEM education and engagement, our project-based systems engineering curriculum aims to add to the existing body of effective instructional approaches for stronger collaboration, problem-solving, and engineering skills in students. We designed and tested our curriculum at Acera, an independent Massachusetts school for science, creativity, and leadership. Elementary school students at a four-day Acera camp participated in our systems engineering project: building a smart model of a LEGO city. Split into teams, students earned badges for developing skills such as Python coding, and Robotics as they ventured to build a school and a town hall, a transportation system, and even a renewable energy source. Our field observations and interviews revealed patterns of motivation and applications of systems thinking in our students. We found that gamification, badges, and earnable points both engaged and united students by rewarding growth in STEM skills and setting achievable, tangible, class-wide goals. Students encountered problems head-on, working on faulty code or missing railroad pieces without direction from an adult, demonstrating our project's facilitation of implicit motivation. Students also communicated across teams by suggesting new tasks, which was rewarded with class-wide points, or adjusting their own work based on the results of another team, demonstrating an adoption of systems thinking. All of their efforts culminated into a city of many moving parts—motorized trains, color-sensor cars, windmills, and conveyor belts. Each part was made by a different team, so each team had to collaborate across disciplines to create the LEGO city.**

***Index Terms*—systems engineering, engineering management, project management, complex systems**

I. Introduction

As engineering projects become increasingly complex, the need for an intermediary role that integrates various project components has become increasingly apparent. This role has evolved into systems engineering. As defined by the The International Council on Systems Engineering (INCOSE), systems engineering is "a transdisciplinary and integrative approach to enable the successful realization, use, and retirement of engineered systems, using systems principles and concepts, and scientific, techno- logical, and management methods" [1]. System engineering roles was typically filled by engineers with experience in the related technical field and in management [2]. There has been an increase the past decades of formal systems engineering in educational institutions [3], which would indicate the need of systems engineers in complex engineering projects. Systems engineering roles may differ between industry and application, but they follow similar practices and fundamentals. The basic principle of systems engineering is to integrate systems components in the most practical way. This process involves mediating between different engineering discipline individuals and finding "common languages" people can understand. This is achieved by standardizing both management processes and methods of communication among people working on the project.

Bringing systems engineering to the K-12 educational setting presents many challenges. Systems engineering requires the technical engineer- ing knowledge needed to accomplish an engineering project, and the means to integrate builds, which requires effective communication between students working on the project [4]. This might explain why STEM educators tend to either focus on an engineering activity that is done within small groups, or on a non-complex interconnected project. Focusing on engineering and complex interconnected systems is an area that is rarely explored by educators and researchers. If done properly, a system engineering project would unfold new learning goals that would not be achieved through other STEM activities. The nature of complex engineering project adds depth to hands-on STEM learning, and would benefit the students learning, as well as building something advanced that was not possible through individual projects [4].

Another major dvantage of bringing systems engineering projects into schools, is that, as technology advances, it is becoming important for students to acquire a diverse range of skills to understand the technology and contribute to its development. However, it is often the case that a single student may not acquire all the necessary skills for such technology. Thus, there is a need to build distinguished expertise within students. One way to achieve this is to build an environment where we can let students specialized in an area, and finding a mean to integrate their knowledge with other students. This would help students gain the advanced concepts in a discipline, and know how to communicate what they work on with other students, creating a peer-to-peer learning environment.

The university should be ready to prepare engineering graduates that possess these new abilities [3], which included, among other things [4], [5], the technical ability of integrating learnt knowledge and skills and application to solve unfamiliar problems, and the non-technical abilities such as teamwork, project management, multidisciplinary skills, etc. These abilities are not easily taught within the traditional education system that teaches subjects in isolation, but are best developed in practice.

II. Literature Review

Educators opened the doors for bringing engineering to K-12 education through hands-on projects. This hand-on teaching approach is also known as Project-Based Learning (PBL). This is a teaching tactic where students work with real-world practices, define goals, and execute a project [5]. Project-based learning also helps students learn soft skills and experience leadership roles [6], [7]. Additionally, educators have found that PBL inspires collaboration between students and allows teachers to only intervene when students ask questions during projects [8]. Collaboration, soft skills, and leadership skills are essential elements to systems engineering projects.

Students enjoy project-based learning classes, increasing their motivation to complete the assignment [9]. Though there are some drawbacks, as with any type of teaching approach, researchers have addressed the various challenges in applying project-based learning when it comes to complex projects that requires multi-team collaboration and interactions [10].

Running long-term projects in schools may not always be a choice, due to the constraints of the curriculum and the limited flexibility on what can be added and taken off a curriculum. Thus, afterschool, and vacation camps, such as summer camps, might be a more suitable option for conducting extensive projects like multi-systems, cumulative projects. The benefits of robotics camps conducted outside of regular school hours have been demonstrated to increase students' knowledge in STEM content [21]. It is also important to recognize that non-school time camps have different expectations for kids, as kids tend to take a break from schoolwork, and engage in fun activities. When developing such projects, we should focus on incorporate elements of fun and engagement while also maintaining the flexibility necessary to effectively run the program.

We only found one attempt in the literature in teaching systems engineering through hand-on activity. A. W. Johnson et al., [3] have developed and tested an activity where they asked students to integrate 2 pre-built systems, in which students in small groups were responsible for both systems and had full control over how to integrate them. This project was able to teach students that complex engineering systems are usually composed of multiple interconnected subsystems, that even if each subsystem functions properly by itself, modifications (and design trade offs) need to be assessed for the system as a whole. Although this project were successfully able to teach students the concept of multi-systems project, we took it a step further by introduce the the idea of integrating systems that are owned by different individuals and teams.

The following project is the second iteration developed by our team. The first iteration was implemented in a middle school science class at a private school in Cambridge, Massachusetts [12], where the project board was first introduced. This iteration utilizes a second version of the project board that will be discussed later.

III. Activity Design

The aim of the activity is to set an environment that mimics how professional engineers work in real complex engineering projects. The selected project must be relatively complex, have multiple interconnected subsystems, and require a large number of people to collaborate to put the project together in a short period of time. Multiple activities have been put into consideration, including building an escape room, building a representation of the solar system, and building a smart model of a LEGO city. Although all of these projects have elements of systems engineering, building a smart model for a city would be ideal, as the system is physically spread, kids are familiar with cities in general, and all of its systems can be interconnected.

What differentiates systems engineering from systems thinking is that systems engineering requires the use of technical engineering knowledge while keeping an eye on the system as a whole [11]. Thus, parts of the city model must have engineering elements in building it, which reflect the use of robotics/engineering kits in the city. These kits were part of the "resources" available to students, and the use of these resources were instructed in the tasks that were assigned to the students.

Skills that we are hoping to teach in this activity are within soft skills and hard (technical) skills categories. According to L. C. Larson and T. N. Miller [19], students need to learn 21st Century Skills to prepare them for the future. They listed soft skills like, communication and collaboration, expertise in technology, and innovative thinking and problem solving as the three main skills students need to learn. Through systems engineering projects, we believe students will learn soft skills, like communication, planning, conflict resolution, decision making, systems thinking, time management, problem solving, and task commitment. Also, we aim, through this project, to teach students how motors work, mechanisms, use of sensors, and mechanical structure integrity. We believe that other skills (in both soft and hard), will uniquely evolve depending on how students progress and how creative they are.

A. Choosing Subsystems

There are multiple ways to divide a city into subsystems. The study team has tested multiple iterations of dividing the project, and the decision of coming with 5 distinct systems was mainly based on how interconnected the systems are to each other. For example, powering the city would impact all other subsystems within the city, while building a factory might intersect with fewer other subsystems. The five interconnected subsystems of the city were: Power, Road, Building, Vehicles, and Train. All of these subsystems could potentially have tasks that require one or more interactions with each other.

B. Project Layout

During the first iteration of the project in [12], a layout of how the city should look was printed and displayed for all people involved in the project. In that project we noticed that the road team was the one referencing the layout when building. Although the final implemented city design didn't exactly match the layout given, it influenced the final project layout design. The decision of including a pre- designed layout is to have a design students can start with. For this iteration of the project, we wanted to explore the ability of students to come up with a city layout design without a pre- existing layout. This would help researchers understand the process of co-designing within this age group.

C. Team Placement Process

There are multiple types of teams that are structured in organizations. According to [13], there are functional organizations, project organizations, and project matrix organizations. Functional organization is forming teams based on skills in different areas, and each functional team can work in multiple projects and subsystems. Project organization is forming people who work solely in a project and don't usually jump between projects until the project is done. Functional teams are technical-heavy, and they need to have good self-management skills as well as a manager who would be responsible for placing them on projects when needed. This team structure style would allow employees to use and properly enhance their technical skills (vertical growth), but it might slow down their other soft skills. On the other side, project teams are more dynamic, and people who are in project teams are more likely to wear different hats and work on multiple roles within the project, which would enhance their soft skills as well as more understanding of the project as a whole (horizontal growth). Implementing functional teams would require more individuals who would act as managers, and those individuals should have a technical background in their area of expertise, which might not exist in a school setting. Project teams are more suitable in this scenario, if we consider this activity as one project, meaning that all its subsystem teams are working together in one project, and the instructor would act as the project manager.

With this teaming type, it would sound logical that every subsystem in this project would correspond to a team. This would also be easily understood by students, without adding another complexity of functionality. Students would only need to know that the project is composed of subsystems and these subsystems are the subteams who would be later assigned to.

The team placement process for this project was through a small questionnaire that was given to students prior to the project, asking 2 simple questions:

- Question 1: Which of these you like??
  - LEGO
  - SPIKE
  - Python
  - Scratch
- Question 2: Which teams you prefer to be in?
  - Road
  - Vehicles
  - Buildings
  - Trains
  - Power

Students were instructed to list 3 choices on the second question, so as to avoid having less than the required number of students in a team. Once the students filled out the questionnaire, the project manager (the instructor) would place them into the subsystems on the project board.

D. Project Board

Unlike individual projects or small group projects, where all students are given the same instructions, system engineering projects raise the need for a project management tool as communication between people on the project. The PM tool also helps the instructor to assign different tasks to individuals working on the project. We chose between a computer-based software and a physical board. Computer-based software has the advantage of scalability and the automation that can be used to take away some repetitive processes. On the downside, these software require computers and include age restrictions that might not be accessible to all students. Also, computers are used by a single user, which means the tool-to-human interaction would occur between the tool and one user, which would take away the opportunity for collaboration between students when interacting with the tool. Physical project management tools would not have the same capability of software tools, but students are familiar with interacting with large-size boards (classrooms whiteboards), which eliminates the need for computers. Students can interact with each other while using the board.

The teams in the project board were color-coded, and the "hard hats" were given to students that matched the color of the team in the project board. In addition to the color coding on the board, a unique shape in each team was displayed on the board to aid people with some degree of color blindness to distinguish teams.

The tool that was used for this project was driven from our previous project [12], which has the subsystems listed in the board. Tasks for each subteam are placed for each subteam in their tasks bank. Students cab take tasks that belong to their subgroup, work on them, and then place them in the "Done Tasks" side of the board. Figure 1 shows the template of the project board used for the project.

IV. Students Motivation

Adults working in companies get motivated differently to do their assigned tasks. Some of those motivation rewards, such

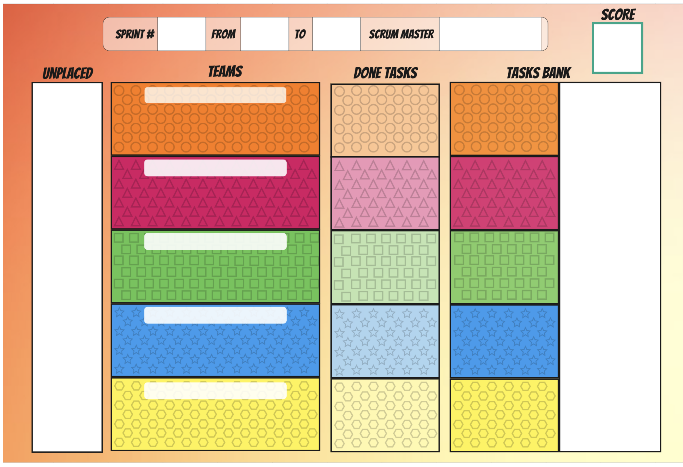

Fig. 1. Project Board

as getting paid, are not applicable for school settings. Thus, we tried to find other motivations for students working on this project.

A. Achieving "something big"

One of the outcomes of collaborating in one project is that people will achieve bigger things together within a constructed time frame. People who get motivated in working on big projects would find the fun in working on these systems engineering projects, and they can "brag" and/or add them into their resume. Some students would find a joy in working on big projects.

B. Scoring System

A scoring system was also implemented in this project. For this project we chose the Agile project management method, which uses a "points" system to track the workload of people working on the project. Each task has a point associated with it. These points reflect the difficulty and/or the importance of the task for the project. There are multiple ways to assign those points, and one of which is the Fibonacci point system. The Fibonacci sequence is a sequence in which each number is the sum of the two preceding ones [17]. This point system helps differentiate between different levels of complexity of tasks. Students were told that all of the earned task points would be summed together. If they achieved a score goal collectively, everyone working on the project would earn a prize. This scoring system would act as a motivation for doing tasks, and would eventually help students help each other, regardless of which team they were on.

C. Badges (stickers)

In addition to a whole-group reward, we wanted to emphasize each student's contribution to the project and the value of each student's unique skills in putting the project together. For this reason, we introduced badges/stickers that were awarded to students if they demonstrated a skill when executing a task. These skills could be technical, like coding, or non-technical soft skills, such as systems thinking. Our goal was for each student to walk out of the project with different stickers than their peers, showing the uniqueness of each person on the project.

Later in this paper we will investigate these motivation rewards, as well as other motivators revealed during the project.

V. Activity Description

We implemented our curriculum in a school break camp at Acera, an independent Massachusetts school for science, creativity, and leadership. Elementary school students at a four-day camp participated in our systems engineering project. Each day was composed of three hours of project work with an hour of break in the middle of the project. On the first day, the project was introduced to the students through the project board, with subsystems and people assigned to each team. We set a table for each team, with hard hats put on the tables. We then called people to sit in their designated tables, and use the hats to meet their teammates and know which teams other people belong to. In addition to the hard hats, resources for each team were also placed on the tables. Some resources were available to everyone, including the LEGO® Education SPIKE™ Prime Set [18], SmartMotors, low-cost robotics tools developed at Tufts Center for Engineering Education and Outreach (CEEO) [14] [16] sorted LEGO pieces the school has, and plenty of crafting supplies. We then showed students where the city would exist. We then kicked off the project and asked students to begin working on the tasks that were placed in their team's task bank on the project board.

Instructors' role was to help students with some technical stuff, like with coding, or using the robotics kits. The major role of the instructors were to write more tasks once teams are done with what was there, or turning what students want to add to the city in form of a task, and give that new tasks points.

Nothing new was introduced to the project on day 2. In the middle of day 3, we assembled a small group of students from different teams in a small meeting room, and asked them to come up with tasks, and write them in the sticky notes similar to what instructors had on the project board. The students were instructed to give those tasks points and were told to follow the Fibonacci sequence when giving points to the tasks. Once they are done with the meeting, we have assembled everyone in front of the project board, and the students who came up with the tasks were told to share those tasks with everyone else.

On the last day, as part of closing the project, we asked 2 students to document, in writing, how the project got done, with highlighting key features of their city.

For collecting the data, we have set up cameras on the students all the time, and we have also individually interviewed students, and asked them questions about the project.

VI. Findings

In this section, we will dive into our findings in running the building of a smart model of a LEGO city activity. All students names used here are fictitious.

A. Activity Execution

Students were asked to build a smart model of a LEGO city. Every team demonstrated some level of STEM complexity when completing the project. All students engaged in the project were excited with what they have created together.

Train team: The train team was instructed, through the tasks in sticky notes, to build train tracks around the city using LEGO-compatible train tracks and robotics tools for the train rolling stock. The team was instructed to make the train move on the track with motors. They encountered multiple challenges when executing their tasks. For example, the train tracks were crossing the road. After discussion with the road team and vehicles team, the train team decided to elevate the track to avoid obstructing the vehicle's team cars. Another major challenge for the train team was having the right wheels attached to the motors. Since there are no compatible components that would fit this purpose, the instructor suggested the team 3D print wheels to see if they fit. After multiple iterations, the wheels were perfectly attached to the motor, allowing the train to successfully move on the track. Although this team didn't have many tasks, the tasks that were assigned to them were complex and time-consuming, which was reflected on the points allotted to their tasks.

Road team: The road team was responsible for creating the layout of the city and eventually putting the whole city together. The road team worked with all other teams in adjusting parts of the city. Once the layout of the city was put together, we asked the road team to build lights around the city using LED lights connected directly to batteries. In addition, the road team was also asked to build an arduino-controlled traffic light. One of the team had a 1-to-1 session with one of our instructors to build this traffic light, and coded it accordingly.

Vehicles team: The vehicles team was responsible for building a car and a truck to autonomously move around the city, using the robotics kits provided. The complexity of their task was in the mechanical structure of the car, the coding, the use of the correct electronics (motors and sensors), and the dimension restriction of their vehicles with the size of the city. The latter task was achieved by effective communication with the road team. Once they had built the car and made it move, they were asked to make the car follow a line around the city using color sensors provided in the LEGO robotics set. With the supervision of an instructor, this team tried many different line configurations to have the car follow lines across the city without expensive coding. They made modifications to the road to make their task more achievable.

Power team: The power team was responsible for placing solar panels and wind turbines were for display only, meaning that they are not providing power to the city. The team was asked to connect the wind turbine to motors that would continuously rotate the wind turbine blades. In addition, they were instructed to build fences around their power plant and include a powered gate. The powered gate was attached to a motor and was controlled by a sensor. Once the number of motors and microcontrollers (LEGO® Education SPIKE™ Prime hubs [18]) was raised in the city, the power team was responsible for building a charging station inside their power plant, and connecting the hubs to the charging station.

Building team: The building team was asked to construct buildings in different parts of the city. They built a school and decided to build a train station inside the school building. The building team worked with other teams, such as the road team to build the poles for road lights around the city, and the train team to build train stations.

The project as a whole was integrated as shown in Figure 2, with every individual students' contribution exist in the city. Students were awarded their individual stickers along the way. The instructors were "giving away" points toward the end to help the students achieve the set group score. The goal was to boost morale and collaboration amongst the students. The reward for achieving the group score was a special sticker (a picture of the city they built). Students placed their stickers on their hard hats and took the hard hats as a souvenir and representation of their achievement.

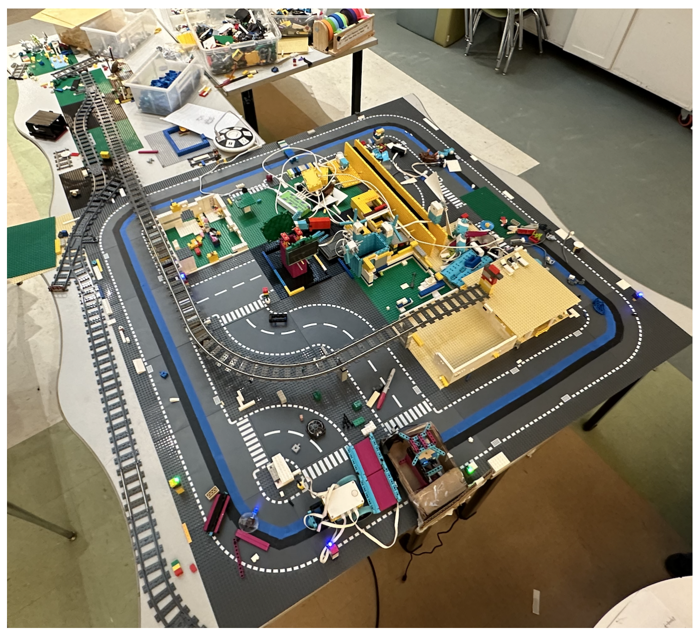

Fig. 2. View of the smart model of the LEGO city

B. Use of The Project Board

The project board was a major part of the development of the project. It helped the instructors display the subsystems of the city, assign students to teams, and instruct individual teams through tasks. Students were able to automatically refer to the project board to move completed tasks and take new tasks from the tasks bank when needed. The project board also helped the instructor bring new students up to the speed of the project by showing the subsystems of the project, and adding new students' names on the board. A snapshot of the project board in action is shown in Figure 3

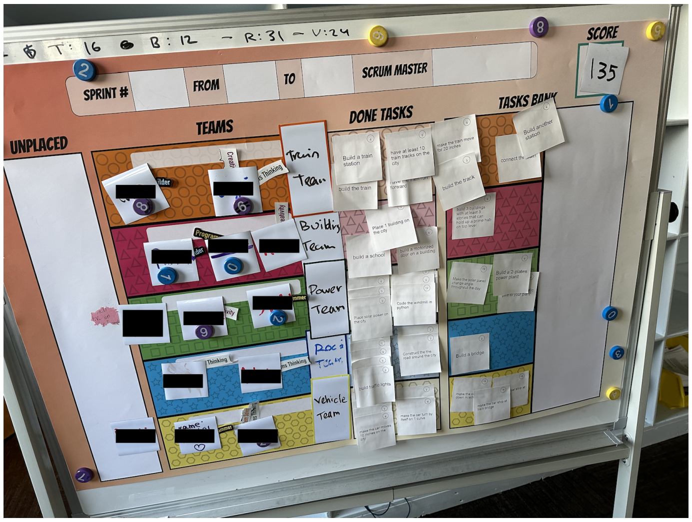

Fig. 3. The printed project board used in the project

C. Learning Goals Observed

Something we tried to investigate through this activity was the learning goals that could unfold when running a systems engineering project. Through field observations and off-site qualitative coding, we found that students demonstrated the use of technical skills and the expansion of their technical knowledge, as well as the achievement of other non-technical learning goals.

1) Systems Thinking and Task Delegation: There were moments in the project where students demonstrated an understanding of systems thinking and the realization of the project as a whole. When asked about her favorite part of the project, a student from the building team, Emma, recalled "When the train tracks fell apart, because when that falls apart, the whole city does not work." Even though this student wasn't working on the train team, she understood the impact of a subsystem on the project, and failing of a part of a system would result in failing the whole system.

Another student from the building team asked the instructor if she could write a task and place it on the board for the power team. The task was to clean up the power plant area. Although the student was not on the power team, she was thinking about the greater good of the project; the teams all share the same space on which they are building the city, so by asking the power team to clean up their area, she is facilitating efficient and neat building of the city.

When a student was asked about her favorite sticker on her helmet, she referred to the one that said "smart city" because it encompassed all of the work that everyone had accomplished. We could see that she is not just thinking about one task, one event, or one team. She is thinking about the group as a whole.

2) Constructive Criticism: There were moments in the project where students made suggestions to one another. These suggestions could be seen as constructive criticism if the communication was effective and for the good of the project. When a student from the road team, Noah, was placing gray road/sidewalk plates as the base of the city, a student from the train team, Liam, said "Noah, there's a slight issue. Here, the crosswalk just goes onto the sidewalk. So, I recommend using that (pointing to another plate)". Liam is aware of other teams' work despite working on his own team. He can be aware of other teams while also making sure to keep up with his own work. In addition, instead of bluntly criticizing Noah's work, Liam provides a reason for the error (crosswalk goes onto sidewalk) and a solution (I recommend using another plate instead).

Another moment of constructive criticism occurred when the instructor asked for everyone's attention because John from the road team wanted to make an announcement. John said to everyone that "We have to build a road loop around the city but, if everybody's working here, we can't finish that." Then, Henry, from the building team voices another problem: "But also we need space to put in the buildings. It can't only be road." As we can observe here, students were able to voice problems to the whole group. In this way, our curriculum allowed students to practice verbalizing thoughts in an understandable manner, with action steps involved.

3) Collaboration: Collaboration is a major learning takeaway from systems engineering projects. Interconnected systems force people to communicate and collaborate to accomplish the tasks. Students have demonstrated collaboration internally, within the same team, and within other teams. An example of cross-team collaboration occurred between a student, Olivia, from the building team and Liam, from the train team. Olivia told Liam that she had a recommendation for the train tracks. She thought that the train team should make a curve downhill to the train station. Liam replied "I'm trying to do that."

As an example of intra-team collaboration, two students, Emma and Olivia, were bonding over working on the project. When Olivia was asked what was her favorite part of the project, she said she "was getting frustrated when coding the train a few days ago, but it was better when Emma joined the camp. We created cool sounds and buttons on the train because we worked together." They acknowledged with one another that together they were able to accomplish more than they would've been able to do on their own. They have an understanding of the power of collaboration and teamwork in solving problems that, individually, could not be solved.

4) Individual Creativity and Problem Solving: One of the criticisms that might be raised when running systems engineering projects, with instructors writing tasks for students, is that it might hinder students' creativity and their ability to solve problems. During our analysis, we saw moments where students demonstrated creativity and brought their own ideas to the project. When Liam was interviewed, he mentioned that when they ran out of a certain type of track. he figured out on his own that he could use connectors instead to make the curves in the train track. There were no instructions or tasks suggesting the use of connectors instead of tracks, but it was a problem Liam encountered during his task. Liam consistently demonstrated independent problem solving and creativity. This project allowed him to work on his own and develop his own ideas, but also forced him to work with other people (like Noah from the road team, who was placing road plates on which he needed to build train tracks).

Also, the small group meeting sparked more creative, authentic ideas from students. Students were able to come up with tasks that weren't influenced by the instructors. One of their ideas was to build an AI-operated police. Although this idea seems impossible to make with the provided resources, it shows that this breakout room allowed them to create tasks and think outside of the box to set innovative and creative goals, like AI-powered technology.

Fig. 4. A hard hard with skills stickers attached

D. Students Motivations

We have seen that different motives push students to work on this project. Awards through stickers was one of the main motivators for most students. Students were eager to get their stickers and asked for stickers once they accomplished set groups of tasks. Once, a student ran to their other friend to exclaim that they got new stickers. On a separate instance, two students were whispering to each other, wondering if the instructor was planning to give them more stickers for doing tasks. We can view this as external motivation to do work. Figure 4 show an example of a hard hat full of individual and team stickers. Also, some students were motivated to continue with the project because they were making new friends, within their teams and from other teams as well. Some students, when interviewed, said they were motivated by a desire to demonstrate their existing skills in the project. Others were motivated because they enjoyed the part of the city they were assigned to.

The motivation of working in this project was clearly seen in some students. There were students who asked if they can stay inside, working on building the city over going outside playing in the playground during break time. We had students who asked if they can use the city for playing with LEGO figurines outside the project hours. Also, we had students who were very upset when instructors told them they need to clean up the city (taking the whole city apart). In that moment, we introduced another group work challenge of taking the city apart in the shortest time possible, and they would get a special sticker if they broke a record we set for the kids. This little activity helped us pushing the kids to work together one more time, and making the clean up more fun and engaging.

VII. Conclusion

Our team has developed a systems engineering curriculum for elementary school students, which we have outlined in this paper. While we cannot say for certain that our project taught the students previously unobtained skills because of limited access to the students before and after the four-day camp, we observed instances of students demonstrating and honing skills such as task delegation, systems thinking, and cross-functional collaboration while engaging in our project-based systems engineering curriculum.

Something worth noting here is that there was a need for flexibility in implementing this project. Throughout the four-day camp, many students were absent, others were added to the project in later days, and others wanted to switch teams. We have mostly granted change in teams as we wanted to keep the fun atmosphere that the project had cultivated.

The project had some difficulties during its implementation. Since every student (or group) has different tasks from the rest, instructors weren't able to give one instructions to all when an issue arises. These moments weren't noticeable in this project, it might be because students have control on which tasks they can work on. In addition, there were few noticeable moments when some students didn't feel comfortable talking to other students or collaborate in a task.

There are other things that could be tried in the future. Researchers could test how collaboration, engagement, and enjoyment change when the students have more autonomy over the project, in terms of choosing their teams. We could also have more of a client figure that the students could speak with to identify product needs and get feedback. This would help students practice preparing formal presentations and could make students feel proud of their work upon satisfying the client's requirement.

The project helped in expanding the area of engineering project-based learning in middle school. The tools and methods that were used here could facilitate students working in complex project, as well as help educators push more learning goals through those tools and methods.

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