The Building Blocks for a Successful STEAM Camp: How to Utilize Learning Blocks to Make Engagement Happen (Evaluation)

Mr. Mike Thomas Pitcher, University of Texas - El Paso

Mike Pitcher is the Director of Academic Technologies at the University of Texas at El Paso. He has had experience in learning in both a traditional university program as well as the new online learning model, which he utilizes in his current position consulting with faculty about the design of new learning experiences. His experience in technology and teaching started in 1993 as a student lab technician and has continued to expand and grow over the years, both technically as well as pedagogically. Currently he works in one of the most technically outstanding buildings in the region where he provides support to students, faculty, and staff in implementing technology inside and outside the classroom, researching new engineering education strategies as well as the technologies to support the 21st century classroom (online and face to face). He also has assisted both the campus as well as the local community in developing technology programs that highlight student skills development in ways that engage and attract individuals towards STEAM and STEM fields by showcasing how those skills impact the current project in real-world ways that people can understand and be involved in. As part of a university that is focused on supporting the 21st century student demographic he continues to innovate and research on how we can design new methods of learning to educate both our students and communities on how STEM and STEAM make up a large part of that vision and our future.

Mr. Pedro Arturo Espinoza, University of Texas - El Paso

Pedro worked in the manufacturing industry as a Quality Control Engineer for some years before acquiring his current position as an Instructional Technologist at The University of Texas at El Paso (UTEP). For over ten years in this role, he has worked with a team of managers that oversee various learning environments and systems in the Academic Technologies Department at UTEP. He leads a group of more than 35 multidisciplinary student employees that help support a wide range of technologies for classrooms and other learning spaces, including videoconferencing rooms. In addition to teaching a Foundations of Engineering course, Pedro also provides technology training on Mac OS X, CISCO networking and various other technology topics. He also enjoys the role of social media coordinator for Academic Technologies to showcase the department's services and events. Pedro received his Bachelor of Science degree in Electrical Engineering and a Master of Science in Engineering with a concentration in Engineering Education from UTEP.

Mr. Hugo Gomez, University of Texas - El Paso

Mr. Hugo Gomez works as an Instructional Technologist at the University of Texas at El Paso, he is focused on expanding the professional and technical skill sets of our students and faculty community to better prepare them for the world of technology today and tomorrow. He works alongside a wide assortment of students, faculty and staff on campus to make sure their technology toolsets are up to date. Furthermore, Hugo provides workshops to over half of the student population at UTEP and as such, has been instrumental in providing the behind the scenes support to all these courses. Mr. Gomez also collaborates in the Learning Lab team to explore and implement new educational strategies in the classroom. Mr. Gomez has a Masters Degree in Engineering Education from The University of Texas at El Paso. He has participated in the UTEACH summer program as a Technology Instructor in which he provided workshops on website design, movie creation and computer networking. In addition, Mr. Gomez teaches UNIV1301 Foundations of Engineering, were students learn academic, personal and engineering skills, among many other abilities that help them understand their opportunities and responsibilities as engineering students.

Mr. Randy Hazael Anaya, University of Texas - El Paso

Randy Anaya, Instructional Technologist at the University of Texas at El Paso. Received a BFA in Graphic Design with a minor in Multimedia design from the Universidad Autónoma de Ciudad Juarez, Mexico.

Received a BA in Media Advertising at UTEP and is currently enrolled as a Master of Interdisciplinary Studies with an emphasis on the use of art and technology in teaching and learning. Randy works on research and development of applying the creative process to workshops, trainings and student engagement. Currently doing extensive research and deployment of emerging technologies to redefine the classroom, mentoring and excellence through student interaction.

Hector Erick Lugo Nevarez, University of Texas - El Paso

Mr. Hector Lugo works as a Student Technology Success Coordinator at The University of Texas at El Paso. He holds a B.S. in Electrical Engineering. He is currently enrolled as a Master of Science with a Major in Electrical Engineering. His motivation and passion pushes him into research in wireless communication, especially in Bluetooth Low Energy and Near Field Communication as well as building projects and fostering innovation with faculty and staff members. As part of the Learning Environments division, the idea to develop, oversee and assess engaging students to expand their knowledge and creativity by innovating new technologies application for Engineering Education is currently under way to engage the university and the community. Concluding, Mr. Lugo's ambition is to encourage students to focus in science, technology and engineer abilities in order to expand their professional potential.

Mrs. Herminia Hemmitt, University of Texas - El Paso

Mrs. Herminia Hemmitt is part of the Learning Environments team in Academic Technologies at The University of Texas at El Paso. She is responsible for coordinating classroom technology upgrades and implementations to ensure project deadlines and anticipated goals are met. Her educational background in organizational and corporate communication is utilized in consultations with faculty and staff about their learning environments in order to correctly match them to appropriate learning spaces or adapt existing spaces to meet their pedagogical and technological needs. Her focus is on the specific user to make sure that classroom needs, technical needs, and/or event needs are met.

Prof. Oscar Antonio Perez, University of Texas - El Paso

Prof. Oscar Perez received his B.S. and Masters in Electrical Engineering from the University of Texas at El Paso with a special focus on data communications. Awarded the Woody Everett award from the American Society for engineering education August 2011 for the research on the impact of mobile devices in the classroom. He is currently pursuing a PhD in Electrical and Computer Engineering. Prof. Perez has been teaching the Basic Engineering (BE) – BE 1301 course for over 8 years. Lead the design for the development of the new Basic Engineering course (now UNIV 1301) for engineering at UTEP: Engineering, Science and University Colleges. Developed over 5 new courses, including UTEP technology & society core curriculum classes specifically for incoming freshman with a STEM background. Prof. Perez was awarded the 2014 "University of Texas at El Paso award for Outstanding Teaching". Prof. Perez has over thirteen years of professional experience working as an Electrical and Computer Engineer providing technical support to faculty and students utilizing UGLC classrooms and auditoriums. Mr. Perez is committed to the highest level of service to provide an exceptional experience to all of the UGLC guests. Mr. Perez strongly believes that by providing exceptional customer service that UGLC patrons will return to make use of the various services the university offers. Mr. Perez enjoys working on the professional development of the students' employees at the UGLC. He shares with his student employees his practical experience in using electrical engineering concepts and computer technologies to help in everyday real-world applications. Mr. Perez has worked with the UTeach program at UTEP since its creation to streamline the transition process for engineering students from local area high schools to college by equipping their teachers with teaching strategies and technologies each summer. Oscar enjoys teamwork, believes in education as a process for achieving life-long learning rather than as a purely academic pursuit. He currently works on maintaining, upgrading and designing the classroom of the future. Mr. Perez is inspired because he enjoys working with people and technology in the same environment.

Evaluation of the building blocks for a successful STEAM (Science, Technology, Engineering, Art, and Math) camp: How to utilize learning blocks to make engagement happen

Abstract

The challenge to setting up the first STEAM (Science, Technology, Engineering, Art and Math) camp can be very daunting to newcomers to the game; you know what you want to teach and even the learning outcomes but you're having a huge challenge in how to formalize that into an actual agenda, schedule, camp, or even a single class. These are all questions that we had when we went to setup our first camp called Tech-E. From that setup experience and with refinement we have created a more formal process in which you merely string together what we call learning blocks to create a simple formula to setup STEAM camps. This same strategy can be utilized to setup classes in a more formal K-12 classroom setting as well.

We will look at how the concept of learning blocks was created, refined, and utilized in our most recent two Tech-E camps. We discuss a hands-on approach and how project-based learning (PBL) takes the center stage in this strategy. We assert that building a camp or even a lesson plan from learning blocks creates a totally immersive and engaging environment for the learner and makes it much more plug-and-play for the designer/instructor.

Our paper will also focus on implementing these learning blocks in a K-12 mixed environment (all grade levels, male and female participants) versus a much more homogenous cohort (all high school, all female) type of camp. A showcase of student products (from reflective pieces to actual creations) will be discussed along with how "check-ins" are built into the learning block challenges; the latter as a means to embed assessment into the project workflows dynamically and strategically without obstruction to achievement and/or engagement.

Introduction

The challenge to setting up your first STEAM camp can be very daunting to newcomers to the game; you know what you want to teach and even the learning outcomes but you're having a huge challenge in how to formalize that into an actual agenda, schedule or camp. These are all questions that we had when we went to setup our first camp called Tech-E. From that process and with refinement we have created a more formal process in which you merely string together what we call learning blocks to create a simple formula to setup STEAM camps.

In this paper we will look at how this concept of learning blocks was created, refined, and utilized in our most recent two Tech-E camps. We will take a look at what learning strategies were utilized in the design of these and how building a camp from learning blocks creates a totally immersive and engaging environment for the learner.

Materials and methods

The concept of learning blocks came about as a result of struggling with the challenges of setting up a STEAM camp. To test the robustness of learning blocks, they were utilized over the past two Tech-E summer camps in both a setting that had a mixed group of K-8 students as well as one that was focused only on female high school students. The learning block strategy was utilized as the primary design instrument for both. The camps consisted of 54 students and lasted one week in timeframe each. The first and last session of camp had a slight variation in times between camps due to check-in procedures and a graduation ceremony. However, all other sessions and learning blocks were identical for both camps.

Learning blocks were designed to take advantage of key concepts found in PBL utilizing backward design methods. PBL is focused on tackling realistic problems using the learner's knowledge, increasing the learner's control over their learning, having instructors that serve as coaches/facilitators of inquiry and reflection, and utilizing either pairs or groups in the process. [1,2] Curriculum is usually developed around a specific activity. However, new methods of design have become increasingly popular, one of which is backward design. This method is focused on the end goal in mind first; what students should know and be able to do and then from there work backwards in terms of designing assessment and activities. [3-6] This concept of backward design was utilized within the constructs of the learning blocks where what students should be able to do at the end of camp was thought about first and then each learning block took on one specific activity to accomplish that end goal. Individual blocks used that end student skill/knowledge point as their end goal and worked backwards to create the make-up of each block. The concepts of PBL and backward design in many aspects mirror what is being called deeper learning. As the National Research Council noted in its recent study, *Education for Life and Work*:

> We define "deeper learning" as the process through which an individual becomes capable of taking what was learned in one situation and applying it to new situations (i.e., transfer) ...The goals included in the new [Common Core] Standards and the NRC Framework reflect each discipline's desire to promote deeper learning and develop transferable knowledge and skills within that discipline. For example, both the mathematics standards and the science framework include a "practices" dimension, calling for students to actively use and apply - i.e., to transfer knowledge, and the English language arts standards call on students to synthesize and apply evidence to create and effectively communicate an argument. [7]

Each learning block was designed to consist of four sections. The traditional PBL teaching strategies are utilized with some expansion in key areas that we felt were missing in the long term goals of most summer STEAM programs, specifically, making the connection to a job, career, major, or field of study. Based on this thinking, a learning block is composed of the following sections as can be seen below:

CONTENTS OF A LEARNING BLOCK	
Jobs/Career/Major	A look at what a job, career, major does and how it applies to this block. What fields, majors, jobs make use of the concepts within this block.
Learn-It	A quick introduction to the concepts, words, theory, ideas that are related to what we are doing in this block. For example how does a basic electrical circuit work, how does a computer work, what does "The Cloud" actually do and how does it work.
Do-It **Challenge-It**	A fully hands-on build it, play with it, design it, re-design it section. At least 40 minutes of each block are focused on working with the content within that block in a totally immersive experience. From building a basic computer network from scratch to designing an electrical circuit, a production movie, or a 3D printed object. This section of each block is focused on actually doing something and not just sitting in a chair listening to something. Campers will spend the majority of time in the camp in "Do-It" sections of learning blocks. Some learning blocks have a "Challenge-It" component where campers are presented with a challenge they must overcome to expand the "Do-It" sections by using creative, innovation, or imaginative solutions to common everyday problems.
Reflect and Think About It	At the end of each block(s) campers will reflect and think about what they learned; how they could use it in everyday life; and if the topic is something that they might want to do in the real-world later on.

Learning blocks are then strung together to create a much more dynamic program for a week long setting such as the one seen below:

Learning Block 1	Learning Block 4	Learning Block 7	Learning Block 10	Learning Block 13
Break	Break	Break	Break	Break
Learning Block 2	Learning Block 5	Learning Block 8	Learning Block 11	Learning Block 14
Learning Block 3	Learning Block 6	Learning Block 9	Learning Block 12	Camper Presentation Setup and Practice

The order of a learning block is important. The first portion is specifically tailored to give real world careers, jobs, majors, fields of study that engage the learner upfront. These examples demonstrate what concepts we are about to teach and how they apply to the world around us.

This is followed by a Learn-it phase in which base instruction is given to provide key concepts or knowledge that is needed to perform the challenges ahead. The focus here is to give an overview of the key points that they will need in the next phase but not elaborate on extreme details or specifics in regards.

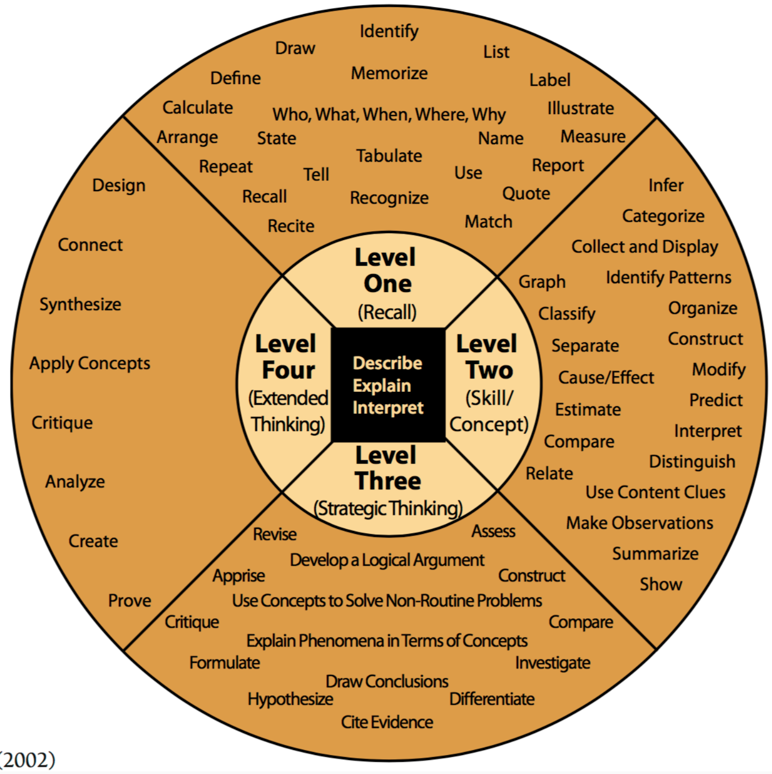
The third portion of the learning block is the section that should encompass a minimum of 40 minutes and/or the majority of the blocks' overall time distribution. This portion is called the Do-it/Challenge-It phase. It is focused on learners working in teams/pairs to solve a challenge hands-on or to apply the knowledge just discussed in some sort of project based learning strategy; the outcome of which many times has no one correct answer. Instead, the solution is left open to multiple approaches based on the learner's utilization of the knowledge gain. The challenge portion can also be stair stepped to allow a list of challenges to be presented with each additional one providing more design constraints or requirements to require further knowledge use, or to explore the nuances of a specific concept in greater depth beyond what was covered.

The final portion of the learning block is the reflection piece. This is a critical piece and as implemented needs a support structure that can facilitate it well. In our camps this piece was heavily supported by a blog/journal type system in which learners could write about what worked and didn't work in their application of knowledge, discuss with others different solutions, and showcase portions that met with great success or failure and reflect on why the felt such occurred. The learning block model is intrinsically focused on creating, evaluating and analyzing why a design/creation was or was not successful.

The fact that the basic format repeats, allows campers to become familiar with the format yet understand that it will be hugely different and new from block to block as content changes and new challenges engage them. Content that is too difficult to fit within a single block can be broken out over the span of several blocks to heavily utilize scaffolding and to grow learner's knowledge over time. Studies have shown that this methodology leads to longer term learner gains [8,9]

To have a greater understanding of how this directly applies to deeper learning we need to take a look at Figure 1 below which graphically represents Webb's Depth of Knowledge taxonomy.[10]

Figure 1: Depth of Knowledge Levels



Source: N. Webb (2002)

As learning blocks are heavily focused on application of knowledge, many of the Do-It/Challenge-It sections revolved around Level 2-4 activities with the majority focusing on Level 3-4 activities but scaled for time. What follows below is a sampling of two badges and two learning blocks. Badges incorporate all the various pieces from all of the learning blocks into a set of achievements in a recognizable way. So a daily badge will require both completion of an engineering themed block, an art themed block, a science themed block, a technology themed block and a math themed block. Each block has multiple deliverables that satisfy various portions of the badge's knowledge requirements. To obtain the badge you must have demonstrated mastery at a basic level of all the goals listed on it.

Environment Badge

This badge is awarded for completing environment da
This badge's goal is to recognize basic understanding

Understand a smart house

Design a smart house

Edit movies

Ability to use advanced 3D design programs

Create a 3D printable object

Understand Environmental Engineering Challenges

Create an automated house

Robotics Badge

This badge is awarded for completing robotics day
This badge's goal is recognize basic understanding of

Ability to take professional video shots

Understand basic electronics

Undertand basics of animatronics

Apply basics of animatronics to working robot

Ability to design in 3D

Ability to design Engineering Journal

Digital Comm.

Learn how we communicate with space
Goal(s): Understand electronics prototyping

Choose a Message to send

Create a digital symbol dictionary

Create a littlebit transmitter

Test your communication system with another team

Modify your data dictionary

Test with comm crew with modifications

Recreate a system from a block diagram

Electron Flux

Learn the basics of electronics
Goal(s): Understanding of electrical engineering

Construct your character.

Use littleBits to animate your character to make the heac

Have your character react when it detects a sound.

Give your character a voice using the app on your iPad.

Remotely have your character move using the cloudbit a

Remotely have your character move to look at someone

Use IFTTT to control your robot remotely

Create promotion video of your robot

To break things down even further, below is a list of possible challenges within a specific learning block. Students are provided the challenge sheet for that learning block at the beginning of each Do-It section. They can accomplish as many challenges as time permits however must check in with a camp instructor upon completion of a challenge to make sure it meets the required mastery of skills before proceeding to the next one. Camp instructors continually walk around and provide guidance to questions, concept misunderstandings, feedback and ideas as teams require such. Below is a small sample of a Do-It Challenge phase within a single learning block. Please note for brevity we have selected to list only one possible challenge at each level within a block. On average, blocks consist of 6-12 possible challenges.

Smart Home Challenge Set (for example purposes listing only 1 challenge at each level):

Level 1 - Using your kit and Legos create a house that has **at least one** of the following items **A)** A room that has a working light in it, **B)** A door that can open and close using the servo, **C)** A room that can detect sound

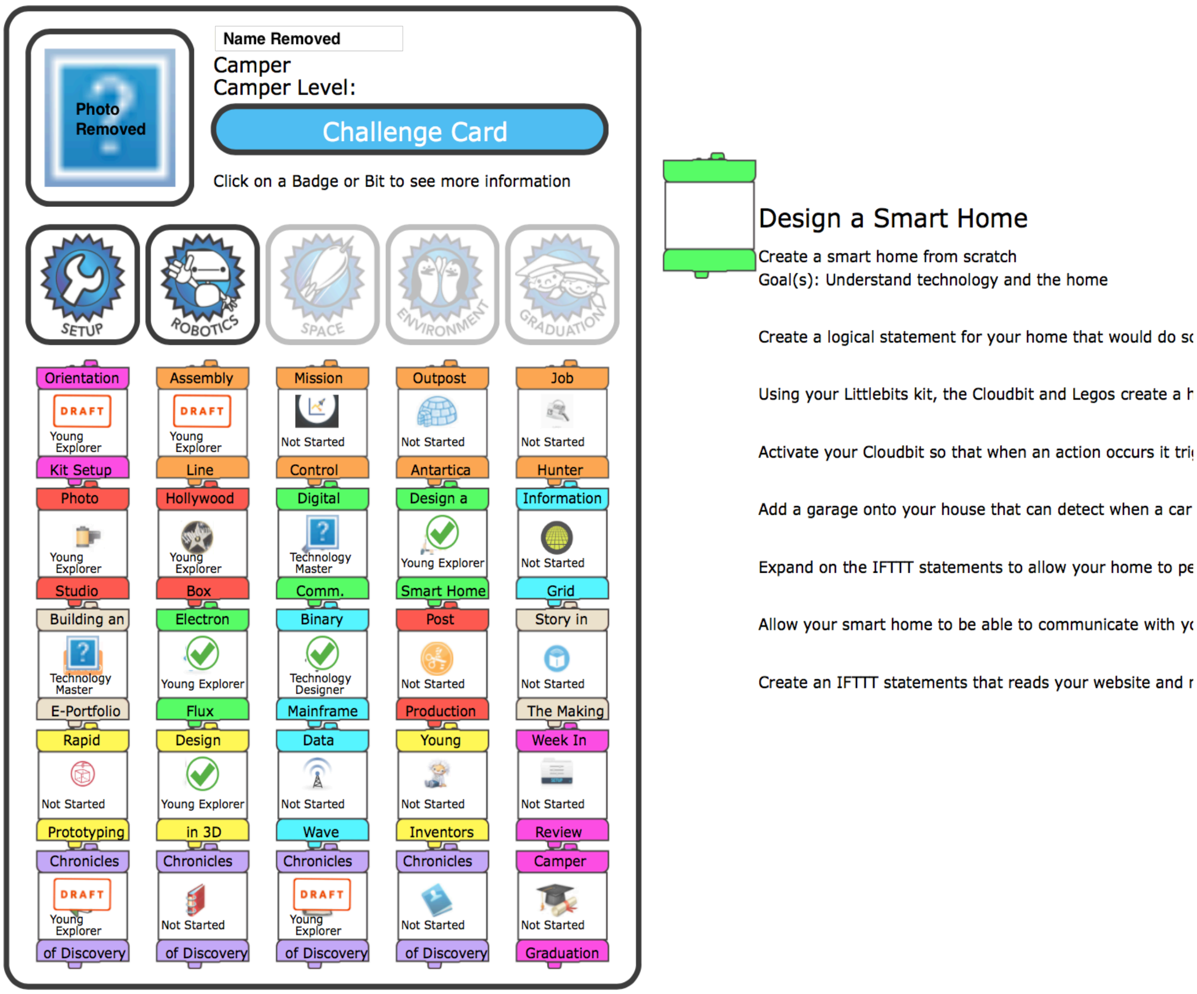
Level 2- Add a garage onto your house that can detect when a car is parked in it (you must also build a Lego car to demonstrate functionality of your working garage as well)

Level 3 - Allow your smart home to be able to communicate with your Engineering Journal site and have it make a post when it detects something happens at your home. What detection features make sense to add to your home? Why did you choose those as opposed to others?

Level 4 - Create IFTTT statements that reads your website and makes changes to your house based on what you post. What did you choose to have it do? Why is this beneficial to a home owner? Does this help in terms of energy consumption of the house?

Level 5 - Pick an enchanted object from a movie, storybook, or fable. Write down what the enchanted object does in the story. Write down how those features would be useful in real life. How can you create a real world object that has those same functions using technology, computer science, and engineering? Using the tools that you have available to you such as the litteBits, Legos, paper, markers, etc. Try to create a prototype or working version of this enchanted object so that you can demonstrate how such works to people. Once you have done such create a video telling people what your object does and why they should buy it.

To give learners feedback and allow parents at a distance to track the progress of their campers, a first attempt was made to create a system in which parents could check on the challenge progress of campers online via Challenge Cards. An example screenshot of the tool can be seen below:



As you can see from the above sample card, learning blocks have various states listed. Below is the list of state and level each block can show:

Learning Block states

Not Started – Designates that a camper has not yet started any challenges within this block

Draft- Camper has submitted a first draft design of a challenge at the specified level

Completed (Green Check) – Camper has finished the challenge(s) and has shown mastery of block at the specified level; this status will change to Draft of the next higher level once a new challenge is started and a draft is submitted for it

Learning Block Levels

Young Explorer – Most basic level deals with demonstrating basic content knowledge without having completed challenges yet

Technology Designer – Has completed at least 2 Do-It challenges within block

Digital Apprentice –Has completed at least 4 Do-It challenges within block

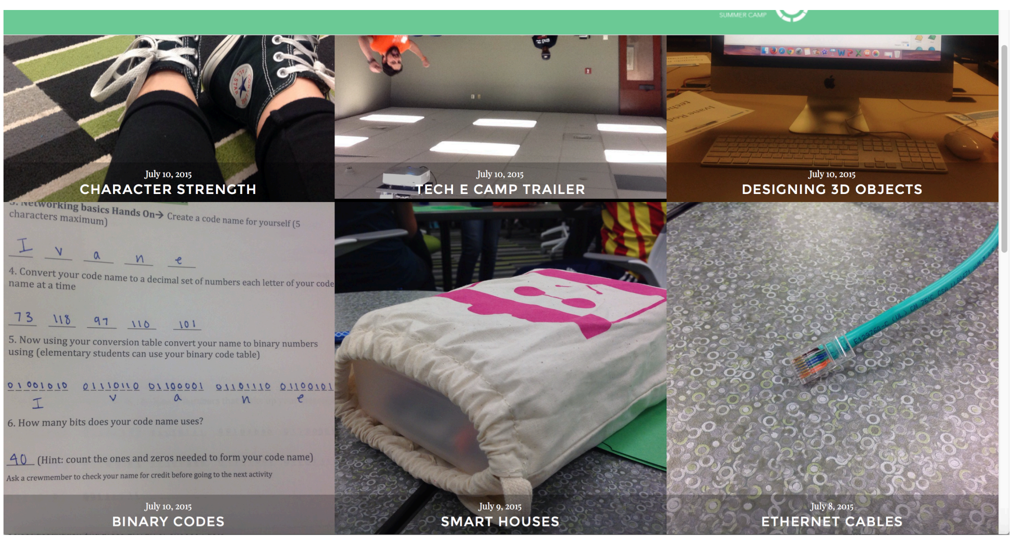
Technology Master - Has completed at least 6 Do-It challenges within block

Technology Wizard - Has completed all Do-It challenges within block

Parents and students were surveyed after the camp to assess their level of engagement with the learning blocks model, how engaging the sessions were and their overall content. Students' learning was assessed using authentic and performance based assessment methodologies; represented in the forms of the level of the challenges completed. Camp instructors had a more formative assessment approach at each challenge check-in in which student teams would not only have to showcase their solution but explain the how, why, what, and terms utilized to check for understanding before getting the green light to proceed forward on to the next challenge. Also as can be seen in the learning block states and levels legend above all challenges require a check-in during a draft phase for evaluation to provide feedback and corrective guidance as needed. These check-in points were also used to to provide guidance to specific teams or individuals struggling with a concept and as additional individualized teachable moments when students wanted to further their understanding to accomplish something at a larger scale for their given design idea. Such feedback is the central function of formative assessment and it typically involves a focus on the detailed content of what is being learned, [11] rather than relying on a test score or other measurement of how far a student is falling short of the expected standard.[12] Research shows that improved learning through assessment deepens on five key factors: Providing effective feedback, student's active involvement in their own learning, adjusting teaching to take into account the results of assessment, recognizing the influence of assessment on student motivation and self-esteem, and assuring students assess themselves on their performance.[13]

Results

The results of utilizing the concept of learning blocks to make a summer STEAM camp showed success in terms of being exceptionally flexible to varying formats, learners, and strategies. The level of engagement, as measured by student participation, engagement, posts, videos, photos, and survey feedback, was well above what was expected. Below is a sample of some posts we got from camper journal blog sites. A challenge we face in disseminating the results is the majority of posts were actually full-fledged videos that describe the steps, the challenges, and market the end product, etc. As such, we cannot replicate these videos in this paper so we are showcasing a sample journal site at the front page level only, which lists the latest 6 posts of a particular camper. Please note that the pictures and in some case the text itself links to a video diary/journal of a camper doing that activity (Screenshots have been cropped/edited to remove camper/team members' names where applicable).



June 25, 2015

3D HOUSE

This is the house I designed with a 3D designing site

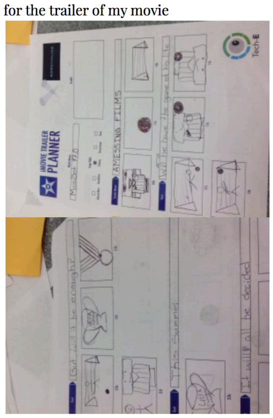
FIXING A COMPUTER

Today I was the Commander in Chief/Master Sergeant of my group in our mission to repair a computer. These are pictures of the parts we used and me assembling them.

June 25, 2015

STORYBOARDS

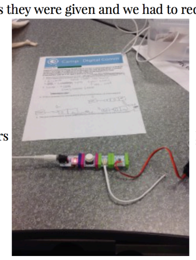
this is the story board for the trailer of my movie



July 8, 2015

COMMUNICATING THROUGH SYMBOLS

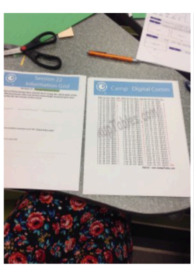
Today we used symbols to send a message to another team. They had to find the message with the clues they were given and we had to redo it in a way that was easier and less prone to errors

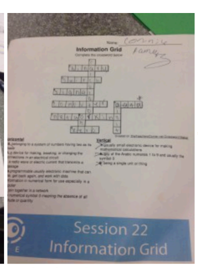


Message

July 10, 2015

BINARY CODE

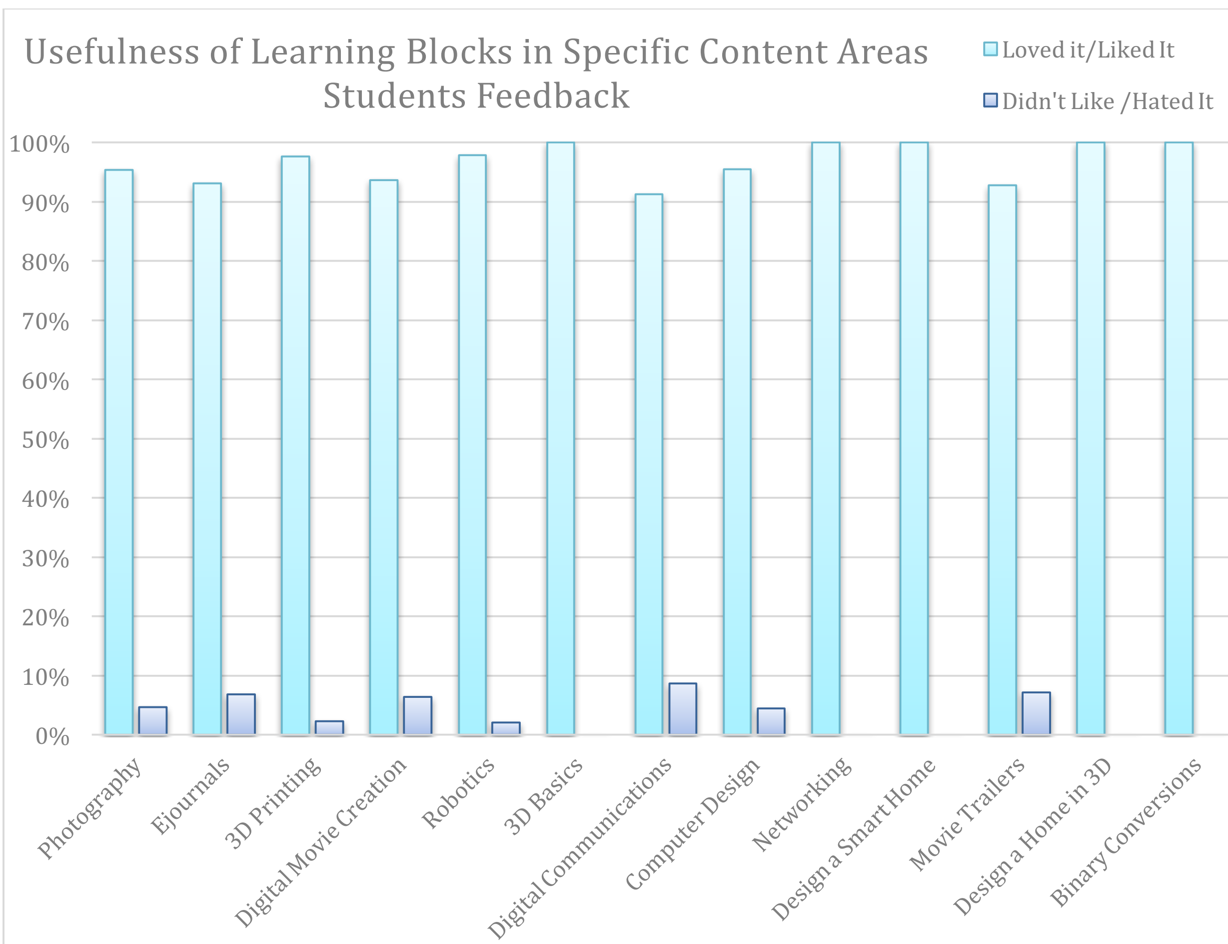




Today we worked on turning decimals into the binary code I found it very easy and interesting. Now we are all part of the 50% that knows how to work the code. Two symbols are used in the binary code they are (10). Next we worked on a crossword puzzle that had to do with words that we have been learning today.

To help the reader understand the extent of journaling, blogging, and video posts, the Tech-E camp site had 54 journals turned in, 1,342 journal postings, 4,682 photos submitted to document processes, and over 700 videos from teams. These ranged from students documenting how a process worked so someone else could recreate their design to actual movie trailers, marketing ads and short films.

The first version of the online parent portal shows promise for future use with parents heavily utilizing such to check-in throughout the day and week. Our anticipated usage was for parents to utilize such once per day per camper to see their progress at the end of the day. However, the online availability of information had parents checking camper status an average of 2.9 times a day or approximately every 1.5 hours of camp for a total of 791 check-ins. This a tremendous amount of parent engagement considering we had anticipated only approximately 270 checks on the status of campers or once every 5 hours of camp time. This presented a longer term issue in which additional tools were needed to allow camp facilitators to update the parent portal quickly and much more effectively throughout the various learning blocks to make the reporting status much more real-time instead of updates at the end of the day.
Students were surveyed after the camp to assess their level of engagement with the learning blocks model, how engaging the sessions were, take on benefits of the programming, and their overall contentment. Below are the results focused on the learning blocks and content:



Only about half of the activities in learning blocks had any negative feedback and of those less than 10% of students did not like the format for a given activity. This suggests that learning blocks can be utilized to create a barebones structure to STEAM camps with a wide range of content areas. Content utilized in learning blocks spanned a wide range of areas, not just specifically engineering themes.

The students' most negative feedback came from activities that were structured outside the learning blocks such as icebreakers and camp check-in which are not shown on the graph above as these activities did not utilize the learning block structure. Additional feedback about length of camp and dislike of being on camera made the list as well. These responses came from the question, "What did you like the least about camp?" and they are listed below in condensed format to group comments with similar intent but slightly different wording (i.e. I didn't like the icebreakers and I would change the icebreakers; would be grouped together):

Summary of feedback received in regards to "What did you like the least about camp?"

"The icebreaker" – this was listed 7 times with different wordings

"Getting everything ready in the beginning, I was already excited to already get started" – this was listed 3 times in various wordings in regards to camper kit setup

"Everything was pretty cool so I don't have anything I don't like"

"Noise in the classroom during the imovie session the least"

"the E-portfolio system took too long to add stuff"

"the hollywood box, I didn't like it because they had to videotape me and I really don't like when people do that" – 3 additional comments were listed in regards to being camera shy

"there only 1 week to be here" – this was listed 12 times in varying language/wordings

"At first I didn't understand the littlebits that much but later on I did"

Student learning was assessed via a formal assessment strategy as teams and individuals were required to check-in a minimum number of times during any learning block when they completed a challenge in order to advance to the next challenge within that block. This created a dynamic in which teams would challenge a problem and check-in via a formal assessment portion with camp leaders. Learners would then either revise the product based upon feedback or proceed onto the next challenge as they satisfied both the challenge and the formal assessment questions from the camp leaders.

It is important to note that students were only able to complete 56% of the total content designed for the camp. This seems to relate more to the the fact that learning blocks are very open and allow for students to take on challenges to varying levels of intensity and depth based on their individual and team interests. Many of the final designs presented as challenge completions far exceeded camp staff expectations in their depth and complexity. A key example is that of data dictionary design activity. Students ventured off to focus first on the meaning of the actual message being sent, pondering whether other cultures could understand the message itself in a cultural context prior to proceeding to the actual creation of a data dictionary and the encoding of the message. While camp staff were more generally focused around the engineering and technical components of that activity, the students themselves delved deeper into the actual process of communication before bringing it back to a technical communication system. This is only one of several examples where students took a different path to completion than was expected. This actually demonstrates the flexibility of the format and was not really the intent as challenges took on much more depth and complexity than they were originally designed to do. The 56% of content completed was not the identical same content per camper as campers could pick and choose the challenges they wished to complete in each learning block. The only rule being that campers could not complete a higher level challenge until demonstrating completion and mastery of a lower level challenge within that learning block. (i.e. you could not complete a Technology Designer challenge (Level 2) without first demonstrating competency of a Young Explorer level (Level 1) challenge and having verified such for skills mastery by camp staff).

Discussion

The fact that STEAM camps seem to be growing in popularity only supports the fact that additional resources and tools are needed to connect these camps with foundational strategies to provide complete solutions. Formats such as learning blocks and the accompanying online report tool for them are important first steps in the process to help understand and utilize deeper learning concepts but a lot more work needs to be done to expand this plan. Curriculum development in the STEAM camp space also is still growing. Deeper learning itself is still very new to the majority of educators and so there are many challenges ahead as we look to fully understand the potential it holds.

From our results we have a first glimpse into the power that such yields in terms of kids building their own paths along a guided road system; however, there is still much to be done. While learning blocks seem to be a first start to developing that road system we have a lot of questions left unanswered that require further insight and study. A challenge we see is who wants to build a huge curriculum of challenges when kids will maybe only explore 56% of that in their learning process. Is that a downfall of the system or a strength to the flexibility of individualized learning? In comparison we may never explore the whole US interstate road system ourselves but others may make use of those roads we do not and to great success to get to their final destination. Does it matter what roads we take if in the end we can all meet up with the same basic mastery of skills? Do those alternative paths provide much more learning in the process for everyone or just some? For future camps we really want to look much deeper into who is going down which pathways and if they overlap, vary greatly, etc; if the answer is yes that out of the 56% of the content each campers completed that their pathways were substantially different then we may have the answer to such. Primarily, we found that out of the 56% of content completed the end results were hugely different between campers' solutions but their solutions were showing key content mastery, albeit in different ways. Those side roads may make a huge difference in individualized understanding and learning. Learning blocks have shown the flexibility to meet those off road trips and still make sure campers make it to the next destination but our new challenge is to see what added value those side trips offer. In the example where students researched cultural differences impacting communication before building a communication system, does this make their system more effective long term versus a team that just designed the technical system? What is understanding a deeper concept worth in the final product? This is something that we cannot answer at this point but something we are being asked to define because the job market is asking for students with deeper understandings.

Bloom investigated that some of the most effective methods on one-on-one learning could be incorporated into a group setting by dividing up content into smaller blocks, implementing frequent assessments and instructor feedback on how improvements can be made, as well as revisiting key concepts which served as the basis for Mastery Learning.[14] Learning blocks try to implement a very similar strategy while focusing on an entire camp process. The next question becomes at what point is deeper learning deemed deep enough?

Conclusion

In conclusion, STEAM camps show real promise in motivating current students to become engaged in STEAM fields. However, without the groundwork and tools required to bring about a more formalized method for planning them, many times it leaves new organizers of camps in a quandary. These tools and methodologies are a first start to shed some light on the behind the scenes planning and foundational structure necessary to design engaging STEAM camps with deeper learning concepts built into them.

The results from our use of Learning Blocks and a Challenge Card system have shown that they can reliably be used to build interactive camps that have large portions of engagement and that their use maintains a positive perception from campers rather than a dislike towards the strategy itself. The learning blocks have shown they can adapt to a wide range of topics and can structurally adapt to individualized learning and exploration when students want more in-depth knowledge about a subsets of the components. The formative feedback structure is well versed towards deeper learning concepts, however, additional feedback mechanisms may need to be added to provide a more standard basis for comparison with traditional testing settings.

Future work

We look to continue and expand upon our toolset in this area by continued work on creating a simple user-friendly interface to connect parents more closely into the learning block strategy. Studies show that connecting parents and community into the process is important for younger learners and, as such, developing a greater toolkit that can be freely shared for others is an area of focus for further study and refinement. We will also look to understand at what point deeper learning goes too deep and begin to distract from core skill mastery; and/or where is the line for the added value of this method of learning.

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