Learning In The Wild Project

"The power of a story is that it has the ability to connect with people on an emotional level."
- Pixar In A Box: The Art of Storytelling, Unit 1: We Are All Storytellers

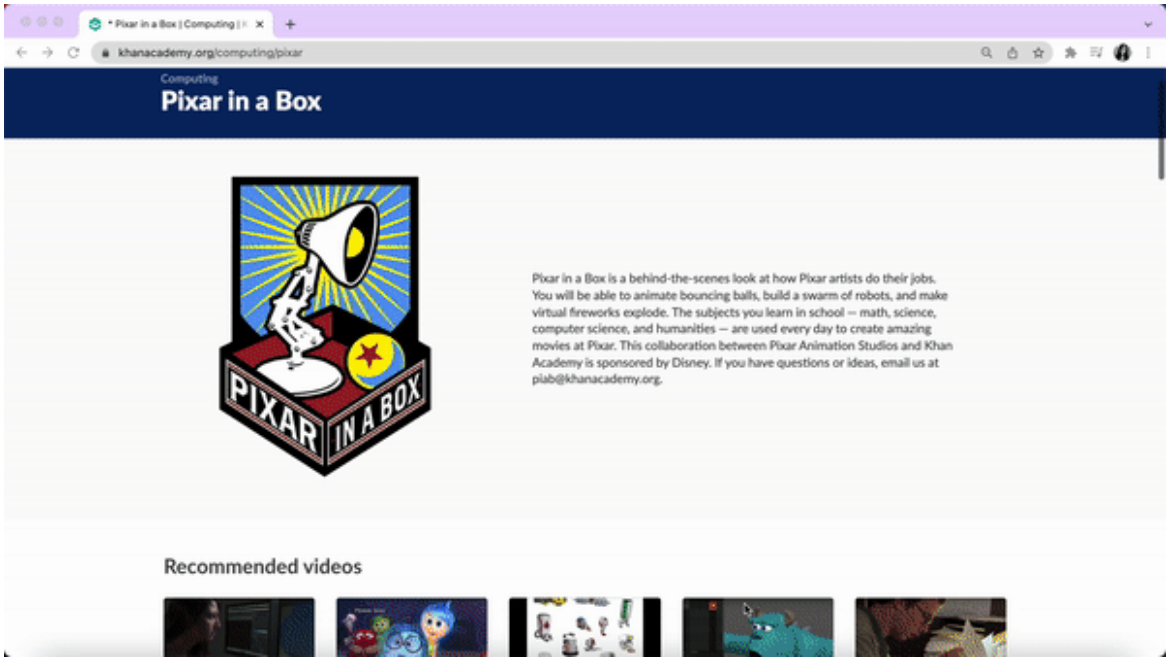
Part 1: Learning Site, Research Questions and Methods

What makes a good story? What does math or science have to do with making movies? How are the subjects I am learning about at school useful in a real life situation? These are some of the questions Pixar in a Box hopes to address, and one of the reasons why we were drawn to observe learning in this particular site.

Observation Site: What is Pixar In A Box?

Pixar in a box (https://www.khanacademy.org/computing/pixar) is a massive open online course (MOOC) offered by Khan Academy in collaboration with Pixar animation studios and funded by Disney. Khan Academy is a non-profit educational organization offering out of the classroom instructional videos and practice exercises on various subjects including, but not limited to mathematics, humanities, history, physics and programming.

Originally published in 2015 but still gaining traction until today, Pixar in a box is a masterclass in filmmaking for kids. While the course can be accessed by anyone on the web, the curriculum was designed primarily for school aged children. Official course description on its website states that the course has materials designed for grade 3 and up. The goal of Pixar in a box, according to its creators, is to get students to see how the various concepts they learn at school can be applied to the various challenges Pixar faces everyday in making movies. With this in mind, we could assume those who engage with the course are students with an interest in learning about different skill sets relevant to movie making and students who would like to upskill their knowledge on topics such as creative writing, coding and animation - along with their learning facilitators i.e. parents or teachers. The opportunity for an adult to take part in the learning process is evidenced by how Pixar in a box also has a dedicated page titled "educator's guide" that can be used to facilitate lesson plans and production modules.



Overview of Pixar In A Box And Its Key Features

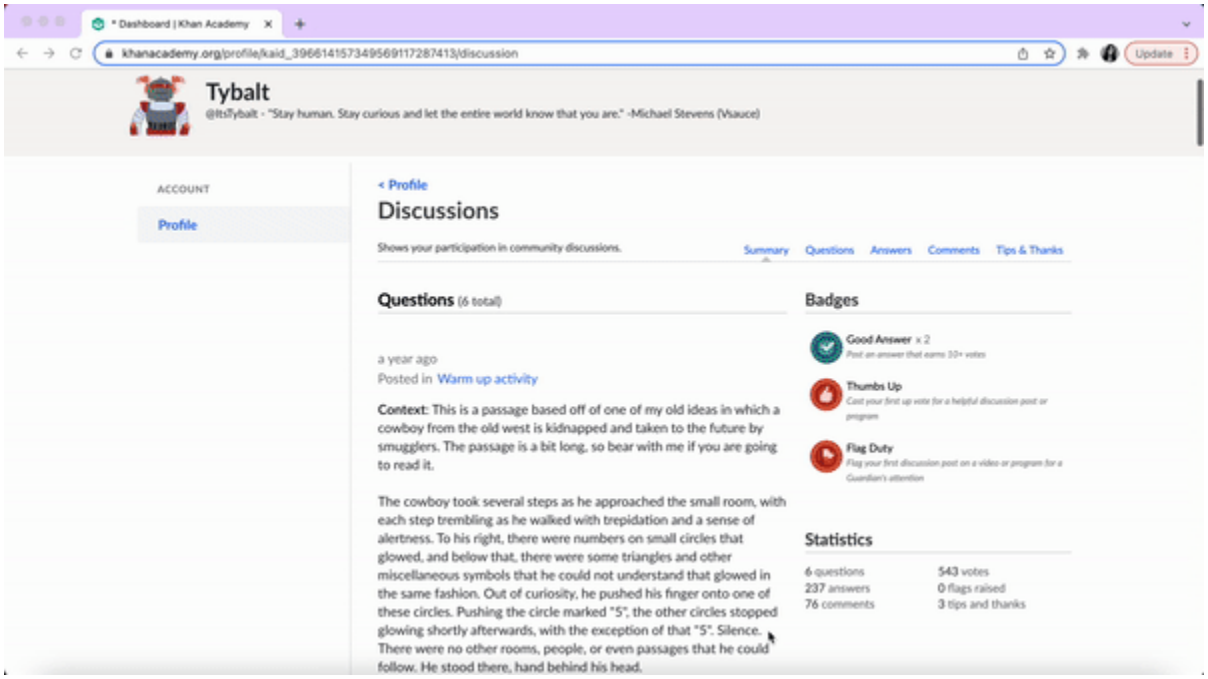
The full course is categorized into thirteen lessons, each broken down further into four to six learning units. Together they cover the end-to-end process of movie making, starting with a lesson on the art of storytelling to a computing class in rendering. While dependent on each individual learners' speed, the entire course takes around 20 to 24 hours to complete (Khan Academy, 2021). Offering a mix between passive, active and constructive learning activities (Chi 2008), course materials consist of videos narrated by Pixar employees, questions and prompts that invite participants to respond or reflect upon the concepts that are taught, guidance for offline experiments as well as quizzes.

Throughout the course, participants are also encouraged to share their ideas in the community forum. These forums can be accessed collectively at the bottom of the courses' front page or gradually at each stage of the different units. Dubbed "community questions", the feature functions much like an online discussion thread, where participants can submit responses, post questions as well as reply, upvote or downvote each other's comments. Participants can categorize their post as a "question" or a "tips and thanks" and sort other users' comments based on the most recent or most popular. The option to contribute to this discourse is only available to those who have gained enough "energy points" (a Khan Academy system that rewards learners based on their degree of participation i.e. the more videos watched, the higher the points) and have verified emails. The forum also comes with a guideline that asks learners to guide one another. Participants are asked to avoid yes or no answers, give feedback and answer each other's questions 'the way your favorite teacher would'. Based on our observation, the availability of this community forum creates a degree of interactivity between participants of Pixar in a box.

Observation Scope and Limitations

There are several challenges in studying learning in an open, online environment. By virtue of the learning site, our primary source of evidence comes in the form of textual dialogues present in the community discussion forum. Our ability to observe how knowledge is constructed relies heavily on what people express and the discourses that were taking place. Throughout our observations and in designing our research methodology, we were mindful of the fact that not all social interaction within the forum equates to learning interaction.

A second concern that we had involves the asynchronous nature and temporal period in which these community discussions take place (Wise & Paulus, 2019). Because posts in the forum are not bound by an expiration date and are essentially available for anyone to respond to forever, we've noticed that there are instances where a user would reply to a thread that had stopped being active years prior. Lastly, the scale of the Pixar in a Box and the way Khan Academy designed its platform makes it impossible to track learners' engagement and drop off rate. There are no features that will allow us to see all the learning units a single learner has completed; nor are there any ways we could identify the number of lessons a learner has participated in. We are, however, able to access each learners' individual profile and see their contributions to Khan Academy as a whole based on a list of questions, answers or comments.



Overview of Learners' Individual Profile

Despite these limitations, we remain optimistic that observing learning in Pixar in a Box is a worthwhile endeavor. Its modern format, chunkable design and wide-array of subjects to be learned creates opportunities for different types of learning in participants as they go through the

course. For one, one can assume that participants might have a completely different take out when learning about story structures compared to film grammar or how to pitch ideas. The themes presented in the course also requires participants to draw upon their prior knowledge and experiences, both of which are prerequisite in the field of learning science and reflective of the cognitive theories that postulates how meaningful learning occurs when learners are able to connect new information with what they already know (Novak 2002, Ausubel 1963).

From the design of the learning site perspective, it will also be interesting to observe how Pixar in a box crafted their materials. We believe that subjects such as computer science and skills like storytelling are fundamental to the development of people's ability to conceptualize knowledge and generate creative ideas. Yet both are also relatively abstract and complex learning experiences often taught to a predominantly older audience. Thus, it will be interesting to see how Khan Academy and Pixar construct the course materials for its intended learners.

Motivation and Guiding Questions

We will be approaching our observations through the lens of constructivism and social constructivism. While we see the two lenses as complementary to one another, each of us had our own focus point of observations that led us to form slightly different research questions.

FF: Constructivism

Creativity is an interesting and incredibly mysterious phenomenon. Although some people insist on arguing that they are simply "not creative", there is extensive research that supports the argument that creativity is an inherent human quality, debunking the often popular belief that "creative" is something a person either is or isn't. In fact, researcher Robert J Sternberg bottles down creativity to a decision a person has the ability to make. Sternberg states, "Creativity is as much a decision about and an attitude toward life as it is a matter of ability", he also says, "The view of creativity as a decision suggests that creativity can be developed"(2006). Regardless of where on the creativity belief spectrum one stands, I believe that all of the learners who signed up to be a part of the Pixar In A Box(PIAB) online learning community through Khan academy had enough interest and belief in their own creativity or the lack thereof to think that they can learn or further develop their creativity through this course. Regardless of their motivation and/or goals for enrolling in this course, one thing is certain and it's that they are curious about the creative process behind the success of Pixar movies.

Considering that the lens through which I am conducting my observation is the constructivist lens–constructivism in the learning sciences argues that knowledge is built or "constructed". Furthermore, learners build new understandings and knowledge on what they already know and have experienced. The constructivist theory draws from Piaget's theory of cognitive development, where he defines schemas as basic units of knowledge that grow in complexity the more we know and learn about a particular topic or subject. Taking the theory of schema into account, I recognize that one of the many challenges that can arise in this

asynchronous online learning community is the wide range of levels of prior knowledge that students in this learning community might have. Another challenge is that students do not have direct access to an instructor, teacher, or expert in the topic to confer with, therefore having to rely solely on the feedback and/or inquiry of other learners in the learning community. That however, is one of the cornerstones of constructivist theory, basically that "learners test their own understanding against those of others, notably those of teachers or more advanced peers." (2005, Driscoll). One of the constructivist conditions for learning is social negotiation which promotes collaborative learning and gives students the ability to understand differing perspectives and/or points of views other than their own. As stated by Driscoll, "...learning in most settings is a communal activity, a sharing of culture"(Bruner, 1986, p.127). Or, to paraphrase Vygotsky and situated cognition theorists, higher mental processes in humans develop through social interaction. Because constructivists hold to these beliefs about learning and thinking, they emphasize collaboration as a critical feature in the learning environment." (2005, Driscoll)

Based on my observations thus far I've seen a lot of collaboration taking place in the forum/discussion board section of Pixar in A Box. More often than not a more novice writer will pose a question related to the video or activity and a more experienced or self-proclaimed writer/creative will chime in by providing guidance, offering advice, or helping clarify confusion. I've noticed also that certain learner questions or comments garner more attention than others, specifically comments related to motivation, strategies, and preferences related to writing creatively.

My preliminary research questions prior to conducting any observations were:

1. How does a learner's prior knowledge and experiences affect their ability to make meaning of instruction?
2. How does a learner's prior knowledge influence their reflections and discussions in social settings?
3. From a constructivist approach to teaching and learning, how does one accurately gauge or assess a learner for mastery of a skill or understanding of content?

Some new questions that arose as I was initially observing the learning environment were:

1. How might a learner's level of prior knowledge affect their motivation and engagement in an online learning platform or environment?
2. What challenges might arise from an online learning environment where learners don't have direct and real-time access to an expert or instructor of the topic and have to rely on the feedback of their more inexperienced peers?

AF: Social Constructivism

The subject of online learning has always been one that I found particularly interesting due to its modern day format and the opportunities it presents to encourage informal learning amongst learners from all walks of life. Coming into the site, I was initially interested to observe

the social interactions that were taking place in the community discussions. Drawing upon the theories of collaborative learning (Camarero et al, 2011) and conversational learning (Thomas, 2002) where knowledge emerges through dialogues, offering ideas to others and expanding or criticizing upon each other's perspectives, I had wanted to focus my investigation on discussion threads in which participants are sharing common interests, issues or inquiries regarding the course materials and discussions where contrasting opinions are taking place.

My initial research questions were:

1. How do people co-construct knowledge in a collaborative learning environment, and how does that translate into text?
2. Role of artefact: what kind of artefacts can be found in an open learning environment and how does that help group cognitive processes?
3. Presence of an adult, expert or more competent peer: how do they present themselves to the group and how does this affect group dynamics?

During the course of my observation, my initial research questions began shifting when I realized the complexity of identifying collaborative learning in an online environment. Although the lens of social constructivism holds a degree of applicability to MOOCs based on its general definition and characteristics, social connection and social learning involves body language - and this is difficult to observe from a digital conversation. Identifying a community through the web is also difficult due to the impersonal nature of participants. I realized that the question I should be asking is not necessarily about whether or not learning is taking place in a MOOC, but how individual and group cognitive engagement takes place in MOOCs and how it relates to learning. Instead of narrowing down on social interaction alone, I shifted my focal point of interest starting with the following question: *how does the process of learning unfold in a MOOC?*

From this, I refined my research question based on the following two dimensions:

1. Individual cognitive engagement:
    - What higher order thinking behavior can we identify in an online forum and how does this connect to learning?
    - What kind of knowledge are learners constructing in this open online environment, and how do those instances translate into text?
    - 'Coming to know': What evidence can we find that shows a learner internalizing and externalizing knowledge in an open online environment?
2. Group cognition engagement:
    - How might learners come to co-construct knowledge in a MOOC?
    - Group dynamics: how might the presence of an expert or more knowledgeable others influence group discourses?

- What are the challenges that can be identified in collaborative learning through an online discussion forum?

Data Collection and Analysis Process

In formulating our research plan, there are three things that we deem most important: objectivity, credibility and reliability. While we do take into account the other seven criterias that makes up excellent qualitative research Tracy (2010): worthy topic, sincerity, rigor, resonance, ethical, significant contribution and meaningful coherence (p.840), choosing to frame our priorities into these the three factors above helps us make decision relating to the method and process we will take to collect our insights and crystallizing our findings.

Objectivity and ethical considerations

For us, objectivity relates to the role we take as researchers and the ethics that are involved during the observation process. Since Pixar in a box is a MOOC where anyone can sign up, we do not necessarily need to gain any permission to conduct our observations. However, we will also need to be engaging with the learning materials in order to understand the context of the community discussion and make inferences from our observations. Thus, we made the conscious decision to take on the role of an active observer but a passive participant. This means that we will watch, read and analyze the course materials but refrain from partaking in the online discourses regarding the subjects. To make sure that we remain objective in observing the discussion post, we plan to summarize the objective of each key unit. That way, we will be able to map out whether or not participants were able to understand the materials that are being presented without putting our own biases and prior knowledge into the data.

Credibility: choosing the evidence that counts as data

As we had previously mentioned, because we are observing an online course and forum, it is imperative for us to be able to truly identify instances where actual learning processes and interactions are taking place. At first, the ideal situation for us would be to have the ability to interview some of the participants who have taken the Pixar in a box course. However, upon analyzing the infrastructure of Khan Academy profiles - we realized that that was not possible because the platform does not have direct messaging features between participants, nor does it require users to share any other identification apart from username and a short biography. With this in mind, we decided to focus our observations on existing threads that have taken place.

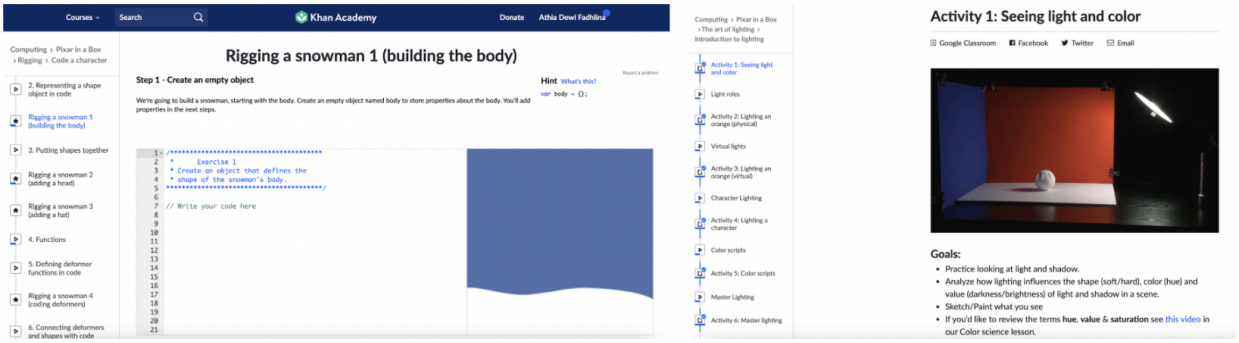
We were pretty confident in the ability to rely on the existing threads of conversations for a number of reasons: one, Pixar in a box is a massive course with a huge archive. The ‘art of storytelling’ lesson itself (not taking into account the computing and coding units) can be broken down to 77 sub units. This gives us at least 77 pages worth of community discussion forums (only by first page, before clicking ‘see more’). There are also six years worth of data and, because the course remained consistent, we can assume that people will still have similar

experiences going through the course today and in the past. The challenge for us then is to process all the information and identify emerging patterns in the most logical and reliable way.

Reliability: purposeful sampling and data collection strategies

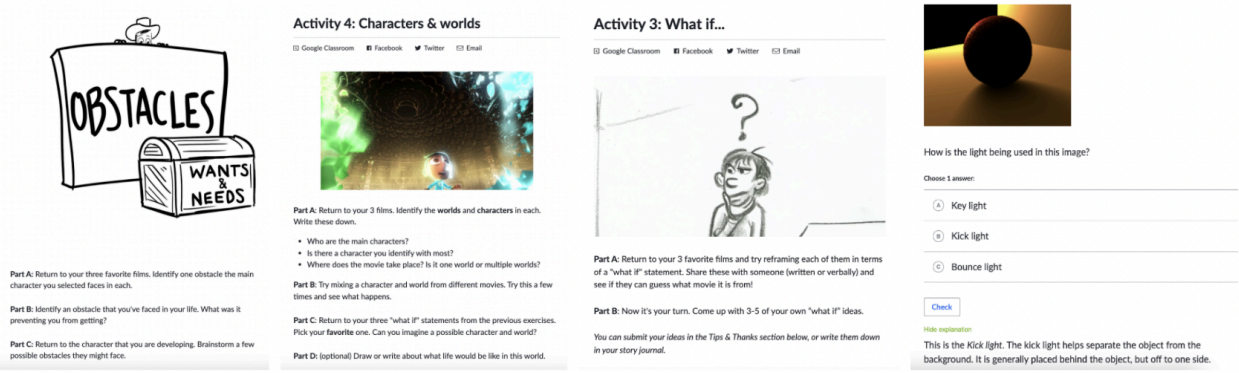
The third conscious decision that we made revolves around the types of activities and interactions that we will be focusing on in our sampling. These two factors go hand-in-hand as how participants of Pixar in A Box came to learn depends heavily on the learning materials that they are presented with. One thing that was apparent to us as we observed Pixar In A Box was that the course is fundamentally tied to the practice of instructionism (Jonassen, 1996). This was natural, given the fact that the main learning material in the course came from industry experts at Pixar. These experts are in itself a community of practice (Wenger, 2014) who are transferring their knowledge by guiding participants to go through a series of chunkable modules and practice exercises. As such, while Pixar in A Box does offer a lot of learning materials, some of the activities that it had also either felt very top-down or are difficult to observe.

For example, in a course about lighting for film, the activities that participants were encouraged to do involves doing offline experiments using the light and objects they have at home. Because there were no ways for learners to submit evidence of their experiments, this was an exercise that we cannot observe. In another class about coding, participants are tasked to practice writing a code to build a snowman. While the discussion forum is filled with responses where learners express their struggles or are asking questions about the exercise, the activity in itself leaves little room for construction of knowledge beyond task completion.



Examples of activities that we deprioritize as data

As such, we deliberately focused on units where learners are given open ended activities. From our initial audit of the learning site, these types of activities inspire the construction of multiple perspectives and present learners with the opportunity to engage in metacognition.

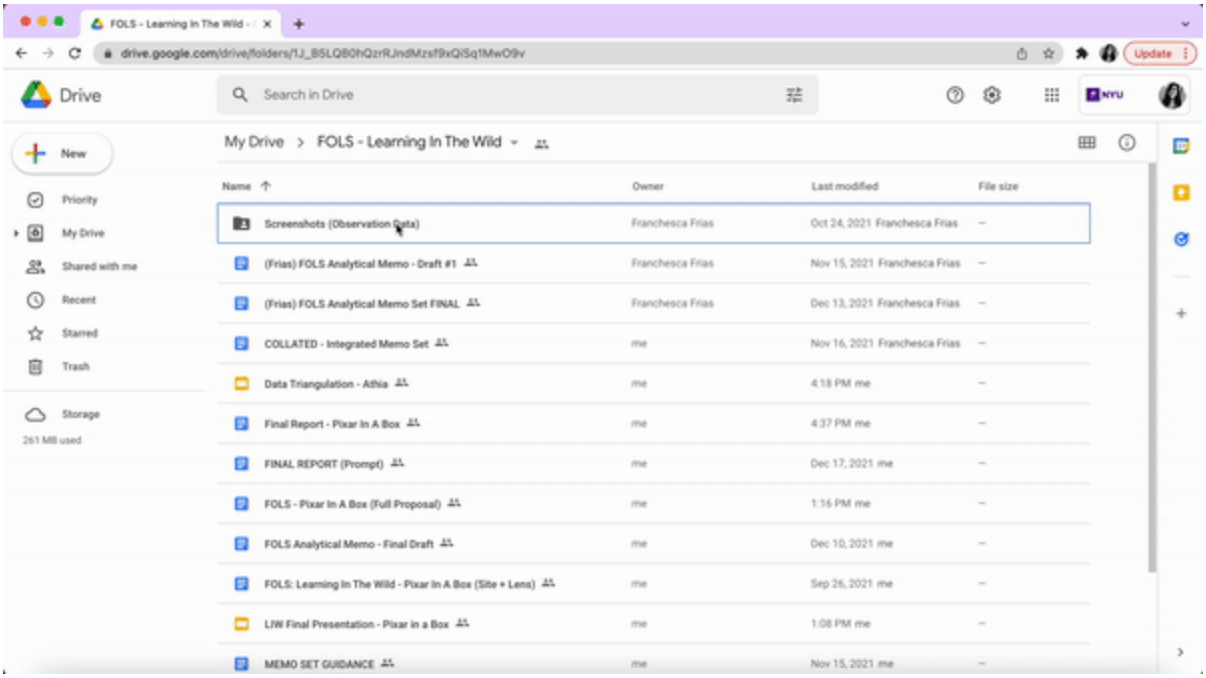


Examples of activities that we see meaningful to focus on our observation

The second parameter that we sought was to identify the types of discourses that are taking place in the forum that we consider evidence of learning. Taking cue from Brinton et al. (2014), we began our observation by focusing only on threads that are "course-related". This means threads or comments relating to technical issues, general sentiment about the course (i.e. this is so fun!) or questions about Pixar as a company (i.e. what do you need to apply to work in Pixar?) will not be treated as data. To further sharpen the types of interactions that we see as data, we implemented the categories outlined by Wise et al. (2017) where "course-related posts" are further defined as ones that either ask or answer subject related questions, state subject related ideas and share or comment upon resources relevant to the subject (in our case, relevant to the course) (p.14). We then used these categories to organize our findings. These categories include the learning unit where we found the evidence, as well as whether the posts were found based on the top voted or recent filter. Setting these boundaries helped us form a shared understanding and common ground as we moved forward in approaching our observations.

Sense-making and data crystallization

Both of us did our own observation separately but relied on a shared Google Drive folder to keep track of each others' notes. Congruent with our decision to become an active observer yet passive participant, we felt that the approach of doing our own observations were helpful as it allows us to embody the kind of role and degree of control learners have as they engage with Pixar in a Box. While at first we were concerned about the potential of having duplication of data by doing individual observations, the variety of responses in the discussion forum also allowed us to infer different hypotheses from the same resource. To keep each other in check, we conducted check-ins at each milestone during the project and discussed our evidence, the patterns that we found and its relation to the theories of learning science.



Overview of our shared Google Drive and the our collated data findings

In total, the both of us combined conducted a total of 20 hours worth of observations. This is calculated by the hours we spent on analyzing the course materials and the time we spent making sense of the threads of what we observed. For Constructivism, a main chunk of the observations were spent on identifying instances of learning that involve participants of Pixar in a Box drawing upon their prior knowledge and metacognition. For Social Constructivism, the majority of the observations were spent on unpacking the art of storytelling (as this is where most open ended activities happen), identifying learners profile, and drawing connections between the learning material and the discourses that were occurring in the forum.

Part 2: Knowledge Claims & Conceptual Framework

Constructivism

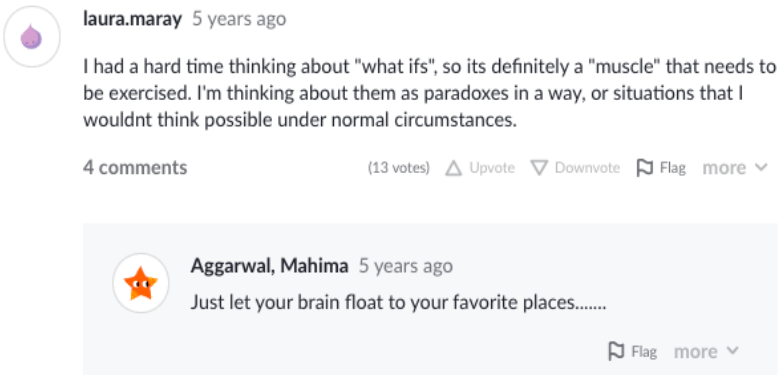
Claim 1: Learning experiences designed to foster collaboration motivate learners to work through the challenge/productive struggle that often preempts learning.

Description: One of the concepts I wanted to explore was related to the effect that a learner's prior knowledge or the lack thereof has on their ability to remain engaged when faced with challenges in an asynchronous learning community. The specific interactions that I'm going to be analyzing and discussing here are related to an activity learners engaged in where they were asked to craft "what if" questions. Prior to engaging in the activity, learners watched a short

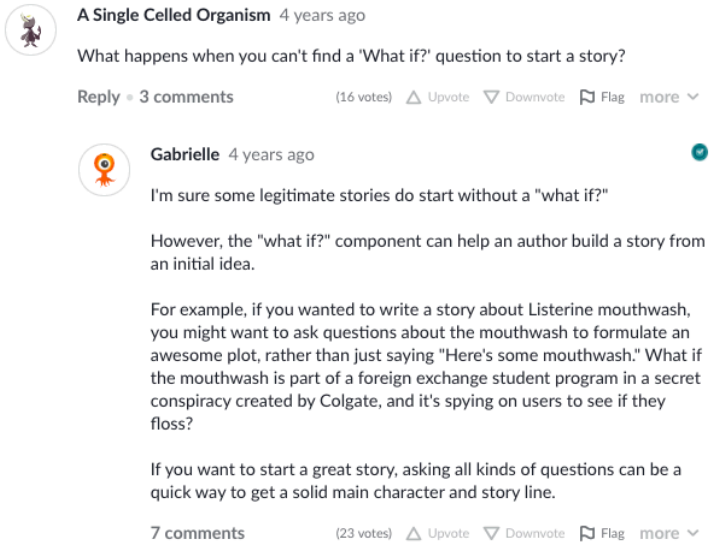
video where different experts in the field spoke about the role that "what if questions" play in the creation of a story. They emphasized that regardless of how complex, dynamic, or elaborate a story might be, they all originate from a "what if…" question. As stated by one of the experts in the video, *"These "what if questions" invite the imagination into a story we want to explore."* After the short video, learners engage in an activity that asks them to think back to the three favorite films that they previously identified and reflected on, they're then tasked with reframing each of them in terms of a "what if" statement and to share them in the discussion board for other learners to try to figure out what they are. Some learners understood the task given to them and shared their "what if" statements, while other learners responded to other posts by guessing what movies the statements were based on.

Observation: In the example below, the learner identified as "Adri Infinity" posted three "what if" statements that are at the top of the thread because of the amount of learner engagement it elicited. Khan Academy allows users to upvote or downvote a comment they either find useful or don't find useful, or to comment. AdriInfinity's contribution got 47 comments of learners who complimented their choice of movies, their what if statements, or simply took a jab at guessing what the three movies were. In the example above we see a learner's attempt at guessing the three movies, although they were unsure of number two, Adri made sure to inform the learners who guessed that the correct answers were *Finding Nemo, Hunger Games, and Pacifier.*

Observation: While some users weren't as confident in their guessing/responses, other users would chime in to either agree with a user's guess or guess something different. To some users this exercise was relatively easy for them to engage in, while others looked to the community of learners for help when they felt like they were stumped, needed clarification or additional support. Some advice or insight provided by other learners is more helpful than others, like the example on the top right is one that isn't insightful, practical, or of much use for a learner who might need some scaffolding or further modeling to help support them with this creative task.



Observation: While in the example below, we see an interaction where a learner poses a question that perhaps other learners were also curious about. Especially those who had a more difficult time with this activity. The learner asked *"What happens when you can't find a "What if?" question to start a story?",* to which another learner identified as "Gabrielle" responded by first validating their question and recognizing that the "what if" question isn't the only formula or way to write a story, but argues that it is a helpful strategy. Gabrielle then provides an example to support their argument and reasoning.



Analysis: Regardless of the level of ease that learners engaged in this activity with, the task, in alignment with the constructivist theory, challenged learners to engage in the practice of drafting "what if" questions. Constructivists argue that learning is more meaningful when learners are able to interact with a problem or construct, as stated by Driscoll, "It is not enough, in other words, for students to acquire concepts or routines that lie inert, never to be called upon even in the face of relevant problems to be solved. Instead, knowledge must develop and continue to change with the activity of the learner." (2005, Driscoll). Providing learners with an opportunity to try this strategy that they've learned for themselves and a collaborative space

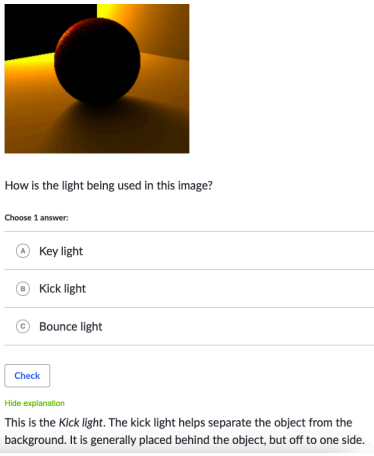
where they're then able to share, discuss, provide and receive feedback, and even go back and revise their original response based on what they've learned and observed is what learning through constructivism is all about. However, I would argue that solely providing an opportunity for practice isn't enough to motivate learners to partake in the learning, especially if there are gaps in their learning or a lack of prior knowledge inhibits their ability to engage in the activity. So to reiterate my initial question, does a learner's level of prior knowledge or lack thereof hinge on their willingness to engage in learning? As noted in my observations, there were learners who already struggled or felt stuck with this activity, even though it was the very first activity assigned. So how do we as designers of learning experiences design in a way that motivates learners who feel lost or stuck from the start to push through that uncertainty, and not just keep trying on their own, but to find the support needed to ensure they push beyond the confusion and achieve the intended learning objective or self-tailored goal?

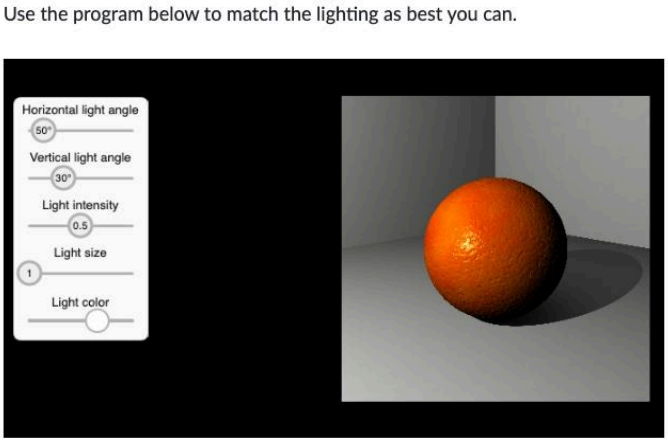
Findings: When learning experiences are designed in a way that fosters collaboration, learners are motivated to work past the challenges/productive struggle, often directly connected to their level of prior knowledge, through the opportunity to engage in dialogue with other learners. A characteristic of the PIAB learning environment that encourages learning through collaboration is the discussion boards, where both joint and instructional dialogue take place. As noted in my observations, learners are continuously engaging in dialogue with each other, in some situations more expert learners take on the role of instructor, while in others, learners build knowledge respectively while engaging in dialogue, both instances resulting in constructive learning. Through collaboration, learners who originally struggled with a task or concept, were guided and encouraged by other learners to work past the productive struggle to complete the task designed by PIAB. This was evident when learners who initially struggled with the task then went back and crafted their own "What If" questions as they were originally prompted to do so.

Claim 2: Online learning environments designed with a constructivist approach promote learner metacognition appropriate to learner motives and goals.

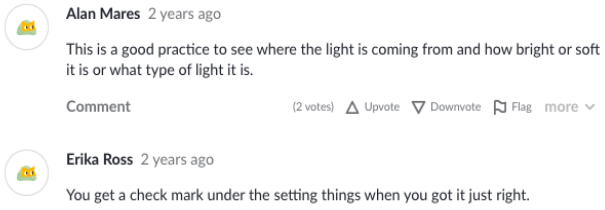
Description: The way that the PIAB learning environment was designed is conducive to the constructivists approach to learning. Constructivists are interested in learners identifying and pursuing their own learning goals. The self-guided modules grant the learner autonomy through the ability to select the topics they are interested in, to revisit a topic they might want to repeat or review, and to tailor their learning experiences according to their personal interests and goals. One of the things that I was curious about was, in a self-guided learning environment, what effects do the communal nature of a collaborative online learning environment have on a learner's metacognition? What opportunities are there for learners to monitor and control their metacognition?

Observation: One of the ways that I observed that PIAB attempts to foster metacognition is by creating opportunities for learners to engage in metacognitive practices, essentially thinking about and assessing their own learning. The example below shows some more explicit forms of checking for learner understanding. We see how after the learner engages with the modules focused on the topic of lighting they are asked two questions to see if they understood how to manipulate/use light to evoke different feelings/moods and/or get a desired look. There's immediate feedback provided in the form of either a minus sign(-) to indicate that the answer was incorrect or a check(✓) to indicate that their answer was correct. The learner can also click on the "explain" option to get a more elaborate explanation related to the correct response.

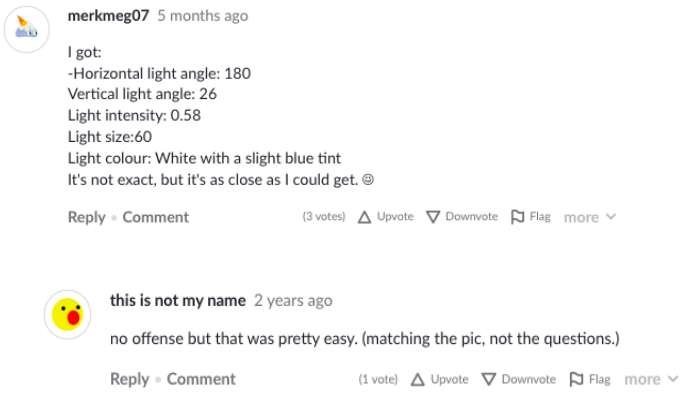




Observation: In that same module learners are then provided with a manipulative and/or simulation that allows them to play around with the lighting angles, intensity, size, and color with the end goal of matching the lighting as best they can. Some learners really appreciated the interactive approach that PIAB incorporated so that they could check their understanding of how lighting is used in real time. Some learners responded by sharing their recognition of the newly introduced approach, while other learners like in the screenshot to the bottom right reflected on the usefulness of this practice and gave some insight related to what they learned through the feedback incorporated in the simulation.



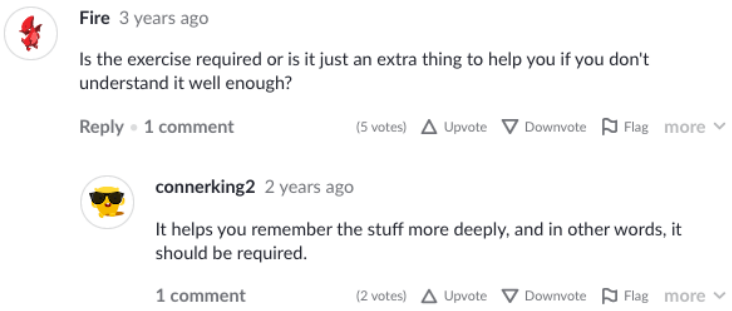
Observation: In the discussion board for this module we see learners expressing their either successful or failed attempts at matching the lighting as tasked. Some users accomplished the task and posted the exact setting adjustments they set to achieve that in an effort to help others, as seen in the screenshot on the right, others simply boasted that it was an easy task, as seen at the bottom of the screenshot, while others expressed their frustrations due to their inability to accomplish the assigned task. Some evidence of how the learner's motives could have influenced the learner's metacognitive monitoring and control can be seen through their reactions to the outcomes of their engagement with the task assigned.



Analysis: PIAB is designed in a way that recognizes that learner's create their own learning based on their individual needs. Because this course isn't linear or has a defined progression, a learner can not only self-pace but also pick and choose what they want to learn according to their personal learning goals. Essentially learners decide for themselves what they want to get out of their engagement with this course, it isn't predetermined for them. As noted by Driscoll, "What distinguishes the constructivist perspective is the placement of the student as "the principal arbiter in making judgements as to what, when, and how learning will occur"(Hannafin, 1992). In other words, students are not passive recipients of instruction that has been designed for them. Instead, they are actively involved in determining what their own learning needs are and how those needs can best be satisfied." (2005, Driscoll).

Findings: An example of a learner thinking about whether or not they should or need to engage in a specific activity can be seen in the example below. The learner is asking *whether or not they need* to complete the activity or if it's more of a support or extended activity for learners who need more practice. To which another learner responds by highlighting the importance of engaging in the activities regardless of how comfortable they feel about the topic because it promotes deeper learning. Thinking back to my research question on the effects that the communal nature of a collaborative online learning environment has on a learner's metacognition, I found that it heavily depends on the learner's goal. As affirmed by Winnie and Azevedo's research on metacognition, "Motives, particularly learners' orientations toward goals

for learning-- mastery, performance and approach, avoidance-- influence learners' metacognitive monitoring and how they exercise metacognitive control." Based on my observations I found that there was evidence of learners with both learning orientations: mastery goal(*desire to truly learn and understand new material*) and performance goal orientation(*desire to be able to demonstrate one's ability to others*). What a user does with their metacognitive monitoring is known as *metacognitive control*, the action they take in response to the results or findings of their monitoring. One thing that influences their monitoring and what they do with the monitoring is the learner's orientation toward their goals for learning–their motivation. Online learning environments designed with a constructivist approach promote learner metacognition appropriate to learner motives and goals, whether they're engaged in learning to truly learn and understand, *mastery goal*, or are they are learning to demonstrate their ability to others, *performance goal*.

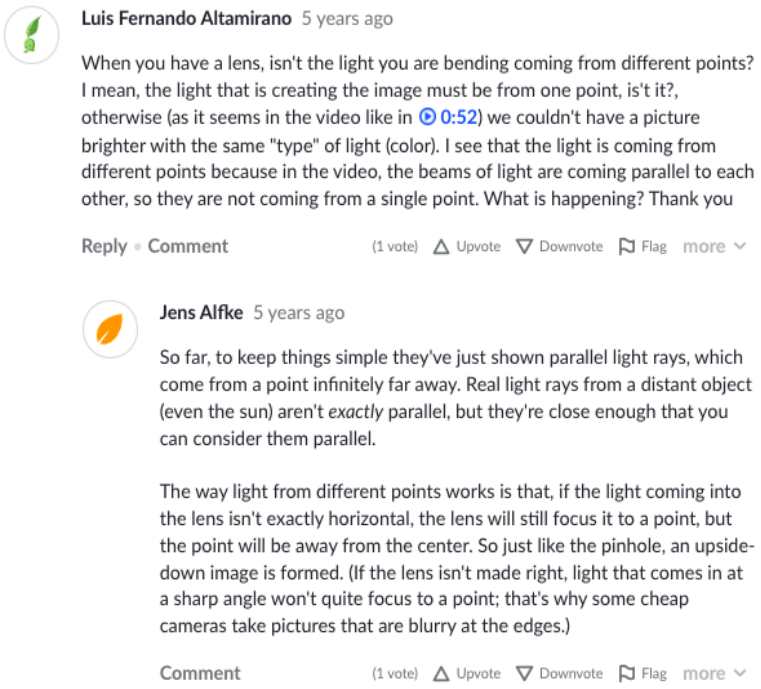


Claim 3: Awareness of a deficiency in prior knowledge, understanding and/or skill motivates learners to seek clarification to bridge gaps in their learning or resolve the dissonance in their understanding.

Description: As the course progresses, the concepts and content taught increases in complexity and becomes progressively more challenging for learners. As aforementioned, the course starts off with more broad concepts like storytelling and lighting and then moves on to more technical topics like virtual cameras, environment modeling, and rendering. In the unit on virtual cameras, learners are taught how cameras function and how they are used to achieve different artistic effects. Learners engage in various lessons that address topics like what are virtual cameras, what is a pinhole camera, focal distance, camera lenses, depth of field, scene composition, storytelling with camera etc. Through a combination of videos, simulations, hands-on activities, embedded checks-for-understanding and quizzes, learners are given a comprehensive look into how virtual cameras are used in Pixar movies. Observing and analyzing the discussion boards throughout the course as the course progresses has been interesting, considering that the learners who have moved past the initial lessons and have made it to the more technical topics, be it through sequential progression or self-tailored order, have shown evidence of the productive struggle that is often a result of lack of prior-knowledge, deficit of skill, and/or exposure to more complex/challenging and unfamiliar topics. I noticed that in the

earlier units there was a variety of comments in the discussion boards that ranged from questions related to the content at hand, suggestions from more expert/experienced learners for the more novice learners, random thoughts or connections made to the content, or learners just announcing their proficiency, understanding, or the completion of an activity. While in the latter discussion boards there are alot more questions from both novice and self-proclaimed more experienced learners, which in accordance to the constructivist theory happens when a learner needs to accommodate newly acquired information to revise or reconstruct an existing schema.

Observation: In the screenshot below, we see a learner who is grappling with prior knowledge and his understanding of the function of aperture(F-Stop) on a camera and its relationship to light. You see that the learner, identified as “Luis Fernando Altamirano”, starts off by posing what seems to be a rhetorical question. As we can see further into his post he then gives a specific example to illustrate the point he is trying to make and then ends his post by asking a clarifying question and requesting for somebody to help him. Here we see an example of a learner who has a preexisting idea on how lenses in cameras work that is challenged by the newly acquired knowledge. As a result, the learner seeks to resolve the internal tension brought about by this dissonance in his understanding. Driscoll notes that this is a natural process of learning through constructivism, the restructuring of knowledge. Driscoll states, "new, particularly conflicting experiences will cause perturbations in these structures, so that they must be constructed anew in order to make sense of the new information."(Driscoll, 2005). This is also an example of social negotiation taking place, where one learner is testing their understanding or constructions against another peer or multiple peers.



Luis Fernando Altamirano 5 years ago

When you have a lens, isn't the light you are bending coming from different points? I mean, the light that is creating the image must be from one point, is't it?, otherwise (as it seems in the video like in 0:52) we couldn't have a picture brighter with the same "type" of light (color). I see that the light is coming from different points because in the video, the beams of light are coming parallel to each other, so they are not coming from a single point. What is happening? Thank you

Reply • Comment (1 vote) Upvote Downvote Flag more

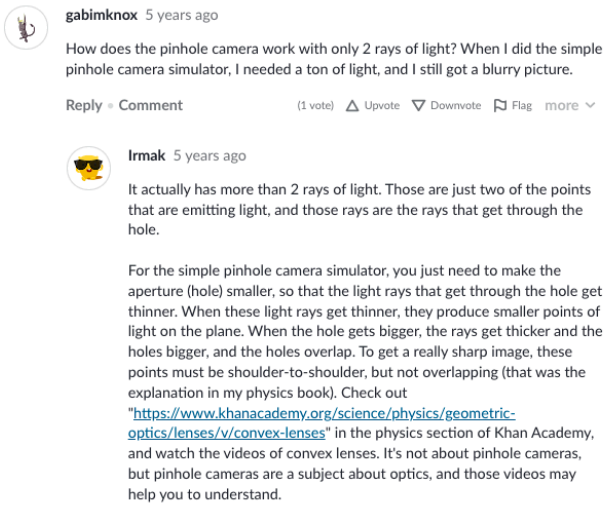
Jens Alfke 5 years ago

So far, to keep things simple they've just shown parallel light rays, which come from a point infinitely far away. Real light rays from a distant object (even the sun) aren't *exactly* parallel, but they're close enough that you can consider them parallel.

The way light from different points works is that, if the light coming into the lens isn't exactly horizontal, the lens will still focus it to a point, but the point will be away from the center. So just like the pinhole, an upside-down image is formed. (If the lens isn't made right, light that comes in at a sharp angle won't quite focus to a point; that's why some cheap cameras take pictures that are blurry at the edges.)

Comment (1 vote) Upvote Downvote Flag more

Observation: As I mentioned in my first claim, one of the initial and recurring questions I had in relation to this learning environment was the effect that prior knowledge would have on a learner's motivation and engagement. Initially I thought that if learners got stumped along the way, this would be enough reason for the learner to disengage and drop off altogether. Especially if there wasn't a teacher/instructor/active presence to hold them accountable. Which I still wouldn't rule out as a possibility that has happened and will continue to happen since that is the nature of a self-guided and self-paced learning environment, where a learner determines how much effort they put in and how long they want to engage in learning. However, as I conducted my observations I found so many instances where evidence of learner confusion, misunderstanding, challenges were present yet learners didn't just stop there. Although one of the many challenges of this learning environment is that we don't have access to individual learners and are able to follow them along on their journey, we could conclude based off of the questions that they asked in the discussion board as it relates to either the learning materials or activities, that learners seeked to rectify misunderstandings and bridge gaps in their learning. In the screenshot below, we see a learner who was engaging in the simulation activity where they were tasked with changing the aperture(F-stop) in the pinhole camera and taking a picture or image. The learner spoke about their experience with adjusting the lighting and how although they thought that was what they had to do in order to get a focused/clear picture, that wasn't their end result. The learner here poses a question in an attempt to get clarification from a more knowledgeable peer. We then see a more knowledgeable peer respond to their question with some insight, firstly addressing the misconception, and then providing a more elaborate explanation to ensure the learner understands. This particular peer takes it a step further and provides the link to some supplemental material that could help the more novice learner extend their knowledge on this specific topic. Here we see how learners rely on the learning community to help clarify misunderstandings that weren't and couldn't be addressed by the learning environment as it was designed. The learning community made up of learners with a wide array of knowledge, skills, and experience serves as a form of scaffolding that makes knowledge accessible regardless of where on the spectrum of knowledge one stands.



gabimknox 5 years ago

How does the pinhole camera work with only 2 rays of light? When I did the simple pinhole camera simulator, I needed a ton of light, and I still got a blurry picture.

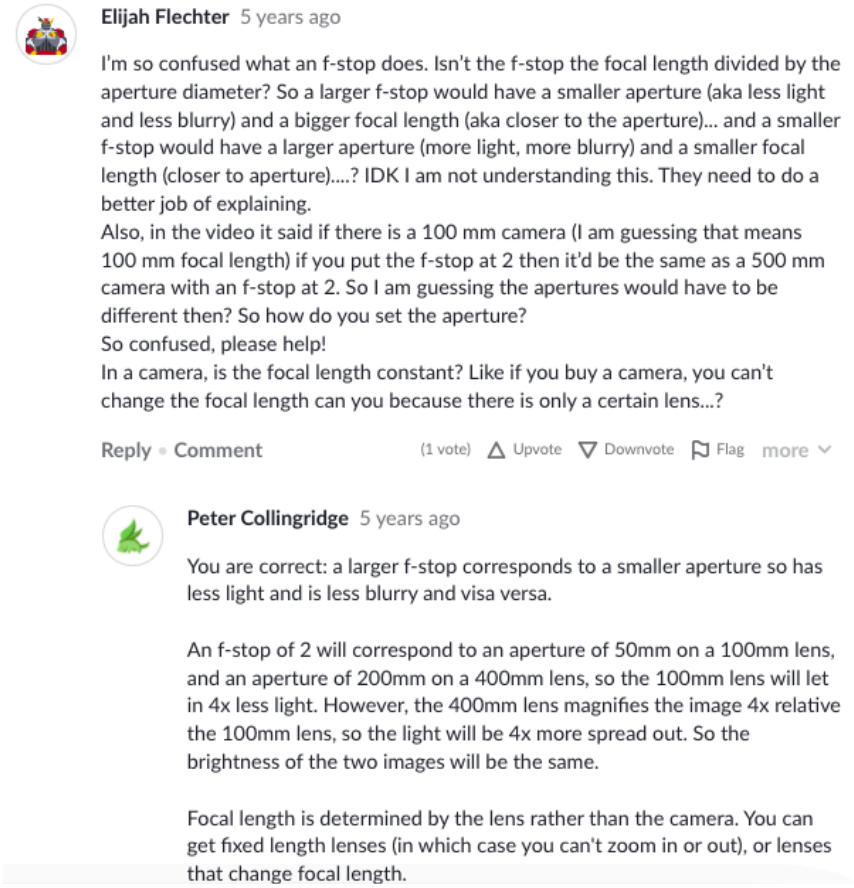
Reply · Comment (1 vote) Upvote Downvote Flag more

Irmak 5 years ago

It actually has more than 2 rays of light. Those are just two of the points that are emitting light, and those rays are the rays that get through the hole.

For the simple pinhole camera simulator, you just need to make the aperture (hole) smaller, so that the light rays that get through the hole get thinner. When these light rays get thinner, they produce smaller points of light on the plane. When the hole gets bigger, the rays get thicker and the holes bigger, and the holes overlap. To get a really sharp image, these points must be shoulder-to-shoulder, but not overlapping (that was the explanation in my physics book). Check out "https://www.khanacademy.org/science/physics/geometric-optics/lenses/v/convex-lenses" in the physics section of Khan Academy, and watch the videos of convex lenses. It's not about pinhole cameras, but pinhole cameras are a subject about optics, and those videos may help you to understand.

Observation: In accordance with the goals of constructivist instruction, Pixar in a Box designed this learning environment with higher order thinking skills in mind, where learners need to use "problem solving, reasoning, critical thinking, and the active and reflective use of knowledge"(Driscoll, 2005), in order to engage in learning. When intentional opportunities for students to assess their understanding and learning of material is embedded in instruction, it serves as much more than just an assessment to distinguish right from wrong, understanding from misunderstanding, these opportunities serve as vehicles for students to utilize their critical thinking and problem-solving skills in order to resolve the problem or challenge that they face. In the screenshot below, we see a learner who is clearly confused about how aperture (F-stop)works and expresses frustration with their inability to comprehend the content by solely relying on the instructional material provided. The learner seeks clarification on the effect that a large vs small aperture and the focal length has on the clarity of an image. The learner elaborates on their question by providing some insight into the way they understood the relationship between focal length and aperture and asks another question in relation to another situation presented in the video where another factor is presented that affects their expected outcome or challenges their understanding of aperture. In this example we see how a more expert peer helps to affirm the learner and provide additional clarification and reasoning to help the learner both rectify the dissonance and add to their schema on aperture.



Elijah Flechter 5 years ago

I'm so confused what an f-stop does. Isn't the f-stop the focal length divided by the aperture diameter? So a larger f-stop would have a smaller aperture (aka less light and less blurry) and a bigger focal length (aka closer to the aperture)... and a smaller f-stop would have a larger aperture (more light, more blurry) and a smaller focal length (closer to aperture)....? IDK I am not understanding this. They need to do a better job of explaining.
Also, in the video it said if there is a 100 mm camera (I am guessing that means 100 mm focal length) if you put the f-stop at 2 then it'd be the same as a 500 mm camera with an f-stop at 2. So I am guessing the apertures would have to be different then? So how do you set the aperture?
So confused, please help!
In a camera, is the focal length constant? Like if you buy a camera, you can't change the focal length can you because there is only a certain lens...?

Reply · Comment (1 vote) Upvote Downvote Flag more

Peter Collingridge 5 years ago

You are correct: a larger f-stop corresponds to a smaller aperture so has less light and is less blurry and visa versa.

An f-stop of 2 will correspond to an aperture of 50mm on a 100mm lens, and an aperture of 200mm on a 400mm lens, so the 100mm lens will let in 4x less light. However, the 400mm lens magnifies the image 4x relative the 100mm lens, so the light will be 4x more spread out. So the brightness of the two images will be the same.

Focal length is determined by the lens rather than the camera. You can get fixed length lenses (in which case you can't zoom in or out), or lenses that change focal length.

Analysis: In the observations above we see different examples of learners acquiring new knowledge, seeking to clarify misconceptions or misunderstandings, or whose existing understandings/schemas are being challenged. We see learners grapple with the content in the instructional videos, try to make sense of the outcomes of the learning activities they engaged in, and engage in dialogue with other learners in the learning environment. All of which become opportunities for students to utilize higher order thinking skills such as critical thinking, problem solving, and active and reflective use of knowledge when faced with the challenges that come with learning. As the topics in PIAB grow in complexity, learners stumble upon more opportunities to engage in problem solving, be it through the understanding of new material or seeking to address the dissonance created as a result of their prior and now newly acquired knowledge. Through metacognition, learners are able to reflect on their thinking and become aware of potential misconceptions or gaps in their learning. The awareness of said misconceptions or gaps, according to constructivist theorists results in learners acknowledging their need for further learning to occur. As noted by Driscoll, "As students determine what subproblems must be solved in order to solve the challenge presented in an instructional video, they discover needs for further learning." (Driscoll, 2005)

Findings: Contrary to my initial assumption that a lack of knowledge and/or deficiency of skills would result in the demotivation and disengagement of learners, in the observations highlighted above we see multiple instances where learners who have a level of awareness of their lack and/or deficiencies seek to rectify the disconnect. Essentially their awareness of the lack and/or deficiency becomes motivation as opposed to demotivation. As stated by Driscoll, "one possible way to deal with the lack of prerequisite knowledge and skills is to identify and ameliorate gaps within the context of the desired problem solving(CTGV, 1992). In other words, a part of solving complex problems involves determining what skills or information a learner needs to know. And learners who discover that, to solve a problem at hand, they must acquire some other skill or piece of information will be more motivated to do just that." (Driscoll, 2005). Now, we cannot dismiss the expressed frustrations by multiple learners in my observations, that the instruction provided by the videos and supplemental materials sometimes just didn't meet the learning demands and needs of certain learners, so what happens then? What happens when the design of the instruction alone doesn't cater to the needs of learners with varying abilities, skills, and levels of prior knowledge? Here is what makes the collaborative component of the way PIAB was designed so crucial: the discussion board helps create an environment where once a learner has identified a need, the environment is designed in a way that helps "them master specific types of information more efficiently."(CTGV, 1991). So a learner's awareness of a deficiency in prior knowledge, understanding and/or skill in turn motivates them to seek clarification to bridge gaps in their learning or resolve the dissonance in their understanding as opposed to demotivating them from continuing to engage in learning.

Social Constructivism

Storytelling is a participatory act that promotes community and shared understanding (Dyson & Genishi, 1994). In education, the act of both teaching - and learning inherently involves telling stories (Lawrence & Paige, 2016). This is why I find the Pixar in a Box massive online course (MOOC) by Khan Academy and Pixar animation to be particularly intriguing. At a personal level, I have always believed that societies are built through a tapestry of stories. Everyone has a story to tell and storytelling helps us make sense of ourselves and the world. My background in advertising and marketing have also taught me that the "life of the mind" is a joint effort. How the construct of our thinking is inevitably shaped by the information, experiences and perspectives we share with others. Taking on the lens of social constructivism, I was particularly intrigued to observe the relationship between individual cognitive engagement and group cognition in an open online environment. Specifically, what are the instances in which we can observe knowledge being constructed at an individual and group level on an online forum?

One key challenge with observing learning in a Pixar In a Box is that there is little to no room to be able to truly see a learners' thoughts and 'coming to know' process. A recurring question that I had in my initial observation was "how do we know that people are learning just by reading their online comments?". At first, I began my observation by looking into the most top voted threads in the discussion forum. While this was helpful to help me identify the kind of conversations that gained most traction, not all of the threads showcase evidence of people learning. Many of these discourses also revolved around people sharing thought starters about a potential movie idea. In my next set of observations, I decided to categorize posts that I found particularly interesting on whether they were posed as a statement or a question. This approach helped identify how a discourse in an online forum begins, but again it does very little to help me understand how learning was taking place. In my final iteration, I decided to apply the passive - active - interactive - constructive (ICAP) framework outlined by Chi (2008) to draw connections between what I was seeing and what it tells me about learning.

Connecting The Dots: Online Learning Through the ICAP Framework

The purpose of the ICAP framework is to link cognitive engagement with active learning outcomes (Chi & Wylie, 2014; pg. 219-243). By using the framework, I sought to connect between the different types of activities learners engage in throughout Pixar in a Box and how it impacts their cognitive processes. While it is difficult to truly apply the ICAP framework to a MOOC setting due to the inability to observe physical gestures, there are various learning activities that participants of Pixar in a Box are exposed to: watching videos from experts (which directly counts as a form of passive activity under Chi's framework), undertaking corresponding exercises, solving problems and responding to each other's contribution.

From a learning design perspective, a key characteristic of Pixar in a Box that I've noticed is that the course is both conceptual and technical. Almost in every learning unit, participants are exposed to knowledge of 'what' and knowledge of 'how'. For example, in the

course on story structure and obstacles, the accompanying video focuses on Pixar employees defining the two terms (‘what’ is obstacle and ‘what’ is story structure) and how both plays an important role in crafting engaging stories (‘how’ to build a story structure and ‘how’ obstacles can be used to add depth to a character). With the exception of learning units such as coding, camerawork and color, most of these materials have no right or wrong answer; rather, participants are given tasks that invite them to make their own inferences.

As I combed through the various community discussions presented in Pixar In a Box, I began to identify the different types of discourses that occur within the forum. One apparent observation that I made is that most of the discourses that were taking place consist of direct responses to the instructions in the learning activities. For example, if the guided activity asks learners to identify the wants and needs of their favorite characters, then most participants would write an answer in the line of “(In Lion King) Simba wants to be free and live his own life. He wants to be king. He needs to put his past behind him and be brave to face his uncle”. I defined this act of repeating or answering the course material as a form of *active behavior*.

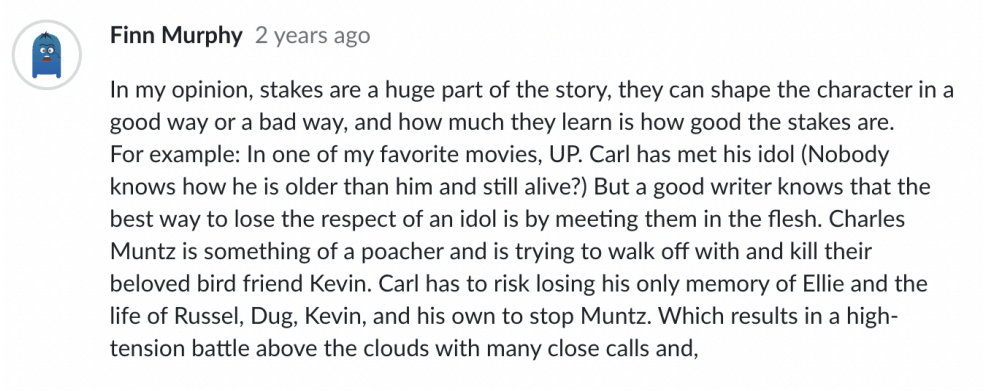
Some learners are more articulate in their answers. For example, in a learning unit on character arcs, a post that caught my eye came in the form of a user named ‘Rif Sal’ who asked “Must all characters go through a character arc to make a good story? I personally don’t think that characters had to go through an arc to make a well told story because if the same formula is used over and over again, it makes the story predictable and the audience will become bored of it”. To me, this is an example of a participant who engaged in a form of *constructive behavior* by asking questions, sharing experiences and producing ideas.

Lastly, I also identified instances where learners are engaging in a form of *interactive behavior*; which I defined as discourses where learners engage in a self construction process and receive feedback . The core of social constructivism is the idea that people's construction of knowledge is influenced by the interaction they have with others and the world around them (Vygotsky, 1978). With this framework in mind, I sought out to form my learning claims.

Claim #1: Pixar in a Box Learners that engage in a more meaningful active behavior share two distinct characteristics: they internalize knowledge by drawing upon prior knowledge and then externalize knowledge by expressing ideas and providing or justifying reasons.

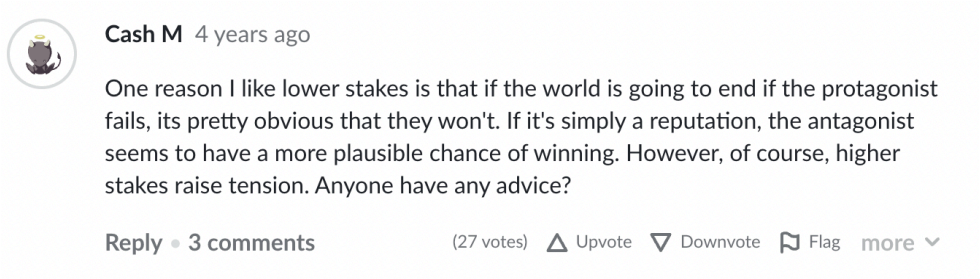
At the core of the constructivism lens to learning lies the belief that learners are not empty vessels but rather individuals who bring their prior knowledge into the learning process (Piaget, 1977). Once I’ve identified what constitutes active, constructive and interactive behavior in Pixar in a Box, I focused my observation to identify different degrees in which active behavior of learning manifests in the forum. I thought to myself ‘if active behavior is defined by learners repeating course materials and constructive behavior is when learners make the effort to go beyond what was presented - surely there must be a middle ground?’. With this in mind, I began looking out for instances where learners weaved in their prior knowledge into the inferences they made about the course material.

An example of where I see this happening is in a lesson about stakes; where the accompanying activity asked learners to reflect on their favorite movies and to pinpoint an important choice that its characters had to make. Then, learners are prompted to try to identify the type of stakes as either internal, external or philosophical and think about their own personal experience of making a difficult choice during their life. In the discussion forum, most of the replies that took place revolved around questioning the difference between stakes and plot twists, or of users sharing the stakes that they see in their favorite movies (i.e. “In Little Mermaid, Ariel had to give up her voice”). Out of all responses the activity received, three posts caught my eye. In one, user ‘Finn Murphy’ responded by unpacking the stakes of the different characters in his favorite movie UP and how their arcs accumulated during the movie. ‘Finn Murphy’ then concluded that stakes are important in a movie because it helps the character grow and learn. Another user ‘Cash M’ articulated that lower stakes are better to watch because there is certainty that the protagonist of the story will be able to achieve success, in comparison to higher stakes that raises the tension of the story. In another, user ‘JasonArron913’ wrote that what happens in most movies is that the audience can already expect which side is going to win, and posits the questions on how stakes in a story can be used to overcome this situation.



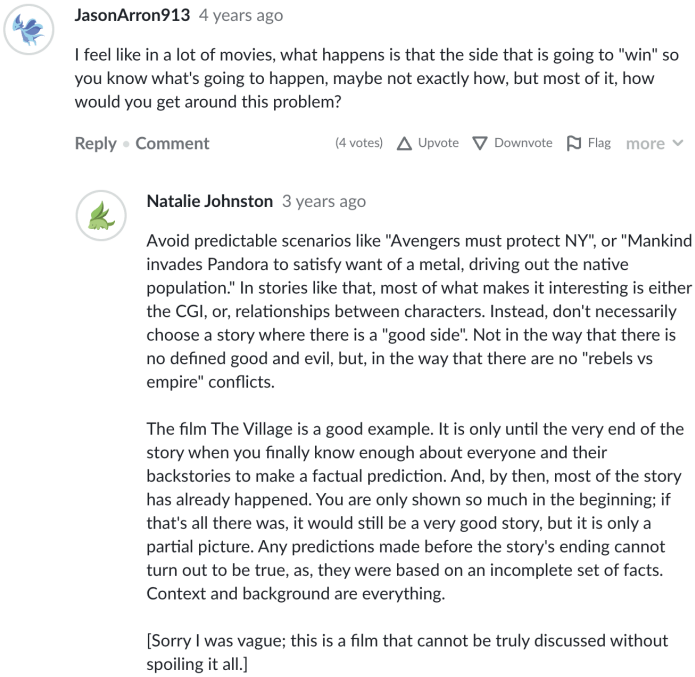
Example 1

The post contributed by user ‘Finn Murphy’ from two years ago caught my attention as it shows an example of a learner constructing knowledge by inferring the cause and effect relationship between different concepts; characters, motives and stakes. While the post started with the user stating their personal opinion on why stakes are important to a story, I would imagine that the user came to this conclusion after evaluating the different characters in UP and how each characters’ motivations helped shape the movie to become more engaging.



Example 2

Despite being shared four years ago, what drew me into the response made by 'Cash M' was the learner uses a contrasting case to illustrate their point. The use of a contrasting case can help learners notice and differentiate the relevance of a new information (Bransford & Schwartz, 1999). By drawing the dots between their past experiences of watching movies and the stakes that were presented in different films, I would assume that 'Cash M' - and other participants who viewed their post would better understand why stakes are an important part of storytelling.



Example 3

While the post by 'JasonArron913' did not gain much traction, the question that they posted did invite users going by the name of 'Natalie Johnston' to reply by offering their point of view on how a movie can be made less predictable. Using the examples of popular movies such as The Avengers and The Village, 'Natalie Johnston' expresses that movies can be made more interesting when the line between who is bad and good isn't so clear. I was interested in their answer as it shows an example of a learners' attempt at identifying patterns from their past

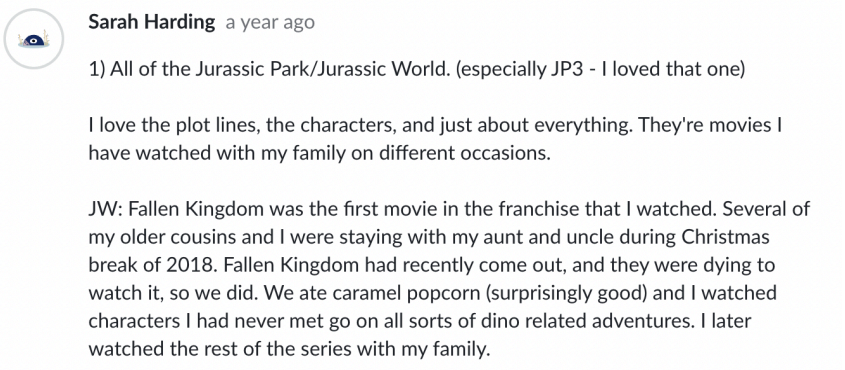
understanding of watching movies and generating questions based on a personal observation. To me, this indicates that the learner is not only taking the new knowledge at face value, but are also thinking about the challenges in applying the concepts they are learning in a real-life situation; thereby engaging in a more meaningful form of behavior that intersects between active and constructive behavior.

Claim #2: Pixar in a Box learners draw upon their prior knowledge and personal interpretations to contribute comments that help them construct a more specific understanding of the material they are learning.

One of the ways learning becomes meaningful is when learners are able to apply knowledge and solve new problems (Broudy, 1997; Bransford and Schwartz, 1999; pg.7). As people, we are constantly trying to make sense of the world around us. To turn this sense making process into meaningful learning, then a learner must be able to connect their prior knowledge with the new information they are presented with. To facilitate this process, Wood, Bruner and Ross (1976) proposed the use of scaffolding. Well designed scaffolding promotes not only replication but also application of behavior. While it has its own limitations - for example, it lacks the feature to provide learners with direct feedback except through the use of quizzes; the entire Pixar in a Box can be considered a form of scaffolding. As a MOOC, Pixar in a Box scaffolded the complex process of creating a story and making a movie into simpler, sequenced sets of modules and activities that learners can leverage on to construct their knowledge.

One of the areas of interest that I sought to examine in my observation is the presence of higher order thinking in Pixar in a Box discussion forum. I wanted to look for instances where learners engage in critical thinking or conceptual building behavior. So I looked for posts where participants are more articulate in expressing their thoughts, with the hopes that it will allow me to gain insights into their thought processes.

I found such an example in a learning unit about ‘obstacles’ and ‘themes’, where I noticed the same participants who go by the username ‘Sarah Harding’ offering their thoughts in the discussion forum. From their post in the first parts of the course where learners are asked to share their favorite movies, ‘Sarah Harding’ expresses that they love Jurassic Park.



Sarah Harding a year ago

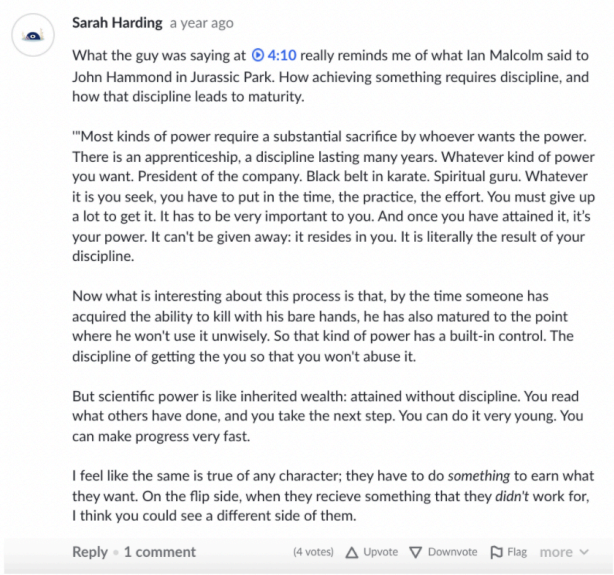
1) All of the Jurassic Park/Jurassic World. (especially JP3 - I loved that one)

I love the plot lines, the characters, and just about everything. They're movies I have watched with my family on different occasions.

JW: Fallen Kingdom was the first movie in the franchise that I watched. Several of my older cousins and I were staying with my aunt and uncle during Christmas break of 2018. Fallen Kingdom had recently come out, and they were dying to watch it, so we did. We ate caramel popcorn (surprisingly good) and I watched characters I had never met go on all sorts of dino related adventures. I later watched the rest of the series with my family.

The first post ‘Sarah Harding’ posts in the Discussion Forum

I was intrigued to observe ‘Sarah Harding’ for two reasons: one, when I clicked on their profile, I could see that ‘Sarah Harding’ had contributed a number of responses towards Pixar in a Box at different units throughout the course. Secondly, I was drawn to how ‘Sarah Harding’ articulated their opinion. In sharing their opinions, ‘Sarah Harding’ would often draw inferences between Jurassic Park and the conceptual knowledge they are learning. For example, in a unit about character arcs, one of the Pixar experts states in the learning video that “having characters that just achieves things without going through a process doesn’t feel authentic”. It would seem that ‘Sarah Harding’ resonated with this statement, referencing the minute where the statement was made and then connecting this information with what they noticed about the characters in Jurassic Park; quoting the movie where the characters of Ian Malcolm and John Hammond converse about having discipline, maturity and how achieving something often requires making sacrifices. ‘Sarah Harding’ then drew the conclusion that great characters are one that had to work to earn for what they want and this is what makes them resonating to the audience.



Sarah Harding a year ago

What the guy was saying at 4:10 really reminds me of what Ian Malcolm said to John Hammond in Jurassic Park. How achieving something requires discipline, and how that discipline leads to maturity.

'"Most kinds of power require a substantial sacrifice by whoever wants the power. There is an apprenticeship, a discipline lasting many years. Whatever kind of power you want. President of the company. Black belt in karate. Spiritual guru. Whatever it is you seek, you have to put in the time, the practice, the effort. You must give up a lot to get it. It has to be very important to you. And once you have attained it, it's your power. It can't be given away: it resides in you. It is literally the result of your discipline.

Now what is interesting about this process is that, by the time someone has acquired the ability to kill with his bare hands, he has also matured to the point where he won't use it unwisely. So that kind of power has a built-in control. The discipline of getting the you so that you won't abuse it.

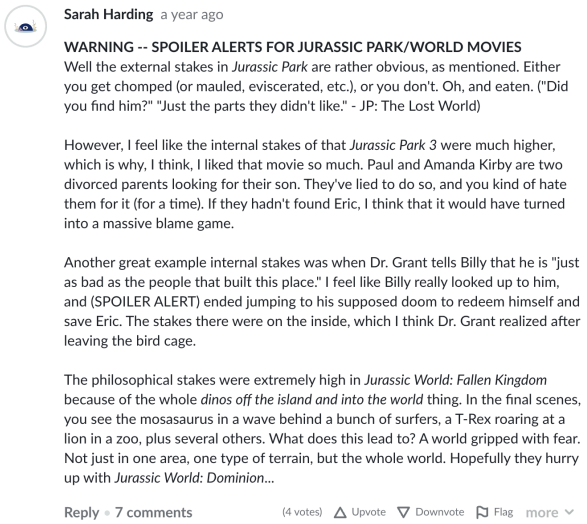
But scientific power is like inherited wealth: attained without discipline. You read what others have done, and you take the next step. You can do it very young. You can make progress very fast.

I feel like the same is true of any character; they have to do *something* to earn what they want. On the flip side, when they recieve something that they *didn't* work for, I think you could see a different side of them.

Reply • 1 comment (4 votes) Upvote Downvote Flag more

Example 1

In the same exercise on the role of stakes that was mentioned in the previous claim, ‘Sarah Harding’ also posted their opinions - again by referencing Jurassic Park. The post gained a slew of traction, mostly consisting of other learners who expressed their agreement to the statement ‘Sarah Harding’ was making. Similar to previous examples, ‘Sarah Harding’ exhibits a process of thinking about the cause and effect a stake could play into a story by listing down the different stakes the characters of Jurassic Park had to face, and making contrasting cases in the types of stakes presented in each of the movies in the Jurassic Park trilogy.



Sarah Harding a year ago

WARNING -- SPOILER ALERTS FOR JURASSIC PARK/WORLD MOVIES
Well the external stakes in *Jurassic Park* are rather obvious, as mentioned. Either you get chomped (or mauled, eviscerated, etc.), or you don't. Oh, and eaten. ("Did you find him?" "Just the parts they didn't like." - JP: The Lost World)

However, I feel like the internal stakes of that *Jurassic Park 3* were much higher, which is why, I think, I liked that movie so much. Paul and Amanda Kirby are two divorced parents looking for their son. They've lied to do so, and you kind of hate them for it (for a time). If they hadn't found Eric, I think that it would have turned into a massive blame game.

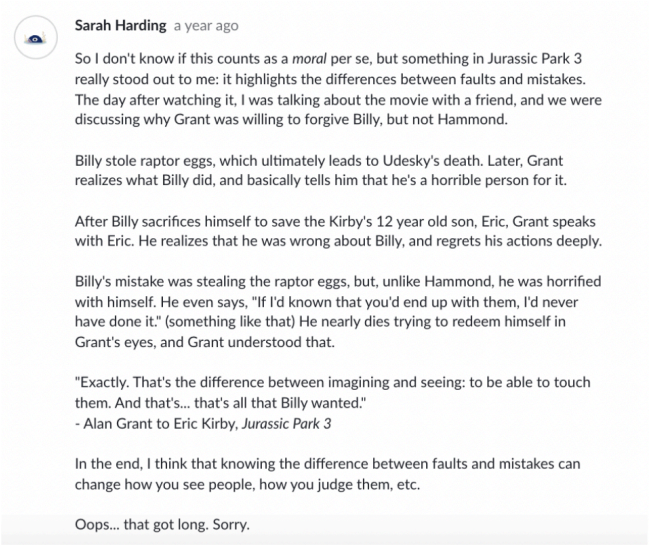
Another great example internal stakes was when Dr. Grant tells Billy that he is "just as bad as the people that built this place." I feel like Billy really looked up to him, and (SPOILER ALERT) ended jumping to his supposed doom to redeem himself and save Eric. The stakes there were on the inside, which I think Dr. Grant realized after leaving the bird cage.

The philosophical stakes were extremely high in *Jurassic World: Fallen Kingdom* because of the whole *dinos off the island and into the world* thing. In the final scenes, you see the mosasaurus in a wave behind a bunch of surfers, a T-Rex roaring at a lion in a zoo, plus several others. What does this lead to? A world gripped with fear. Not just in one area, one type of terrain, but the whole world. Hopefully they hurry up with *Jurassic World: Dominion*...

Reply • 7 comments (4 votes) Upvote Downvote Flag more

Example 2

In the third example, ‘Sarah Harding’ posted a response in a learning unit on themes. The activity in this part of the course asks learners to identify a moral to their favorite movies, encouraging learners to think about what the characters in that movie learns by the end of the film. While the original activity gave learners the option to use their own stories, ‘Sarah Harding’ once again referenced Jurassic Park to construct their thinking. What was interesting to observe was that, apart from making claims about the moral of Jurassic Park, ‘Sarah Harding’ further expanded her opinion to draw a larger conclusion about how the moral of Jurassic Park also reflects real life. In the movie, the character Grant was more forgiving to another character named Billy because Grant could understand where and why Billy did the actions that he took. To ‘Sarah Harding’, this reflects how we, as people, can judge and view people differently when we know how to differentiate between mistakes and faults.



Sarah Harding a year ago

So I don't know if this counts as a *moral* per se, but something in Jurassic Park 3 really stood out to me: it highlights the differences between faults and mistakes. The day after watching it, I was talking about the movie with a friend, and we were discussing why Grant was willing to forgive Billy, but not Hammond.

Billy stole raptor eggs, which ultimately leads to Udesky's death. Later, Grant realizes what Billy did, and basically tells him that he's a horrible person for it.

After Billy sacrifices himself to save the Kirby's 12 year old son, Eric, Grant speaks with Eric. He realizes that he was wrong about Billy, and regrets his actions deeply.

Billy's mistake was stealing the raptor eggs, but, unlike Hammond, he was horrified with himself. He even says, "If I'd known that you'd end up with them, I'd never have done it." (something like that) He nearly dies trying to redeem himself in Grant's eyes, and Grant understood that.

"Exactly. That's the difference between imagining and seeing: to be able to touch them. And that's... that's all that Billy wanted."
- Alan Grant to Eric Kirby, *Jurassic Park 3*

In the end, I think that knowing the difference between faults and mistakes can change how you see people, how you judge them, etc.

Oops... that got long. Sorry.

Example 3

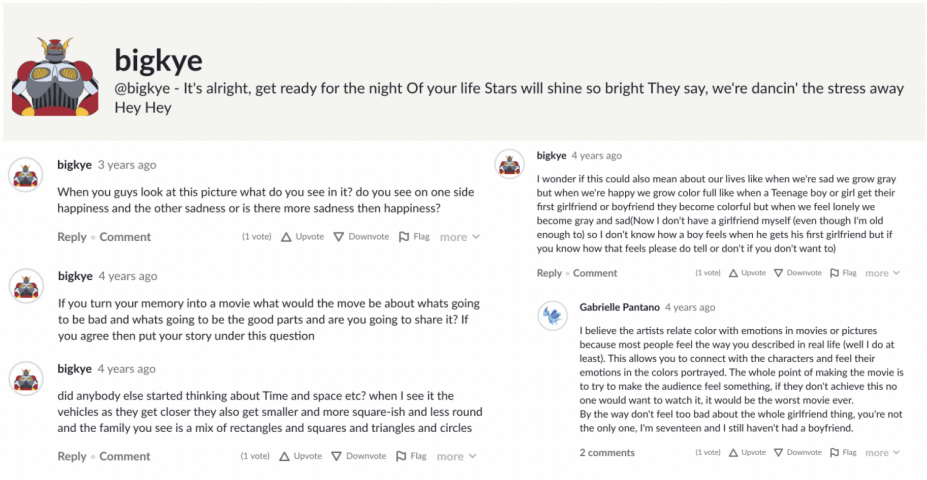
A common thread that I've identified in all three examples of posts from 'Sarah Harding' is the role of prior knowledge and how it can help learners construct better understanding of what they are learning. By consistently reflecting upon Jurassic Park, 'Sarah Harding' was able to construct a better understanding of how character motivations, stakes and themes are applied in an actual movie; thereby allowing them to apply this knowledge into what they understand about storytelling and movie making.

Claim #3: There are three different profiles of learners in Pixar in A Box: help seekers, responders and more knowledgeable others. They can be identified by the transparency of their profile and the type of contribution that they made to the discussion forum.

The lens of social constructivism places great emphasis on collaborative learning; defined by individuals engaging in the meaning-making process and constructing knowledge together (Vygotsky, 1979). By virtue of its design, the discussion forum at Pixar in a Box can be considered a shared space for learners to engage in co-construction of knowledge. But how does collaboration of learning truly play out in an open online environment? Is there a way to dimensionalize the group dynamics and interactions that were taking place? This was a question that I had asked myself as I observed the site.

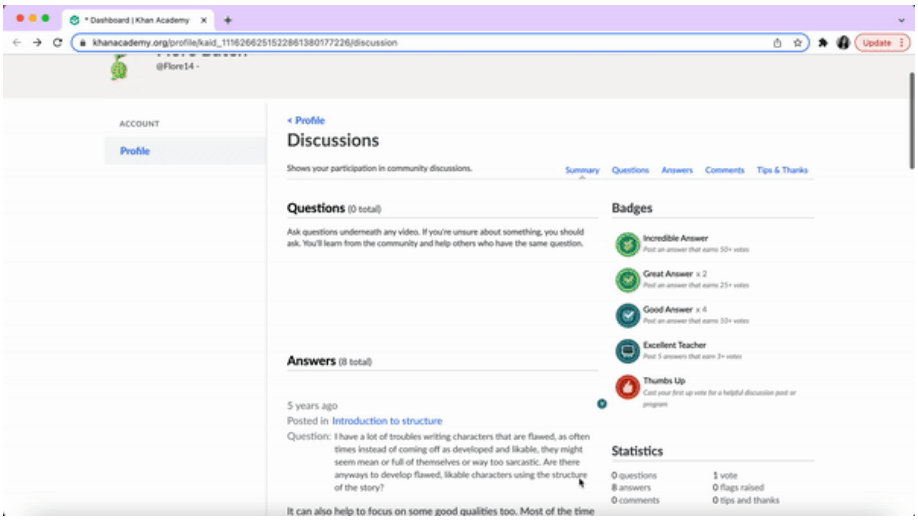
As outlined in our methodology, Khan Academy doesn't have any feature to track individual learners' contributions to the platform. However, the platform does give access to learners' profiles. Much like a social media profile, learners have full control over the degree of transparency in which they disclose their identity. To decipher the different types of learners who are present in the forum, I decided to deploy a dual approach that involves: one, looking at the type of posts a learner contributes to the forum. Second, by assessing the biography learners wrote their profile. Comparing both factors, there seems to be a pattern that I've observed.

The first type of learners that I've identified are help seekers. This profile of learners differs from general contributors by posting questions in the forum. An example of such a user is 'bigkye', whose profile gave nothing away about their identity but whose multiple contributions to the forum centers around inviting other users to share their opinion. To do so, 'bigkye' would either post a question or make statements that begin with sentences such as "I wonder if these colors can be interpreted this way" on a lesson on color tone or "did anybody else started thinking of it this way?" in a lesson about the use of time and space in a story. While not all posts made by 'bigkye' gained traction, there are cases in which it garnered other users to respond.



Example of Help Seekers

Users such as ‘Gabrielle Pantano’ who answered the question by bigkye on color tone by saying that artists relate colors to emotion can be considered as responders. These users contribute to the forum by constructing and offering up opinions based on the posts of others. One example of this type of user is ‘Flore Baten’, whose eight contributions to the Pixar in a Box course all consist of answering other people. Like ‘bigkye’, the profile of ‘Flore Baten’ gave no indication of its identity. But while the total number of contributions ‘Flore Baten’ made might seem small, the profile managed to earn a badge of appreciation from Khan Academy for providing ‘incredible’ and ‘great’ answers. From the way ‘Flora Baten’ articulated their responses, I would assume that they are someone with higher prior knowledge in storytelling. Based on the evidence that was captured, the way ‘Flora Baten’ would respond to other people’s questions involves asking other participants to look at the task from a different perspective. ‘Flora Baten’ would also often stress the importance of context in storytelling. In one example where a user expresses their struggle to write a character who is flawed, ‘Flora Baten’ responded by saying that it helps to focus on good qualities too, stating that characters that they found most engaging from their experiences are characters who have redeeming qualities.

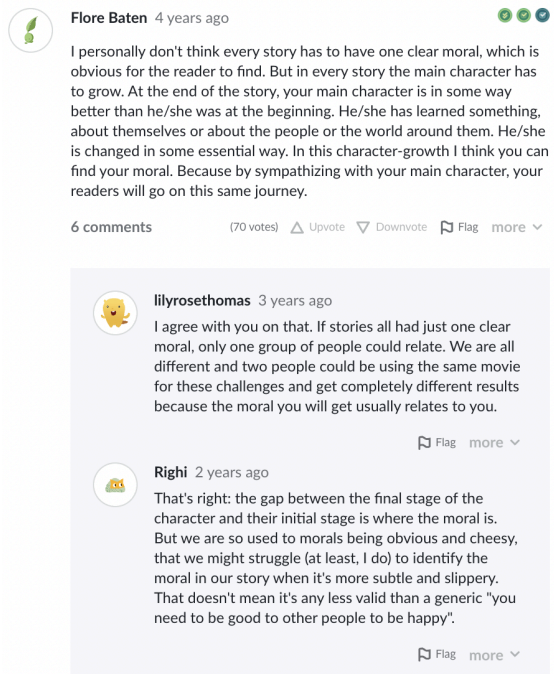


Example of Responders

Apart from the richness in the way they articulate their posts, another pattern that I've observed in the contribution responders could make in the forum is by allowing other learners to leverage on their statement to help make better sense of or expand upon their knowledge. For example, in a thread about themes and morals, 'Flora Baten' replied by first saying that they personally do not believe that a story has to have one clear moral. What matters most is that the characters in the story grow. Outlining why they came to this conclusion, 'Flora Baten' concluded their post by saying that if an author can sympathize with their characters, then their readers will be able to do the same. The post garnered 70 upvotes and a few comments.

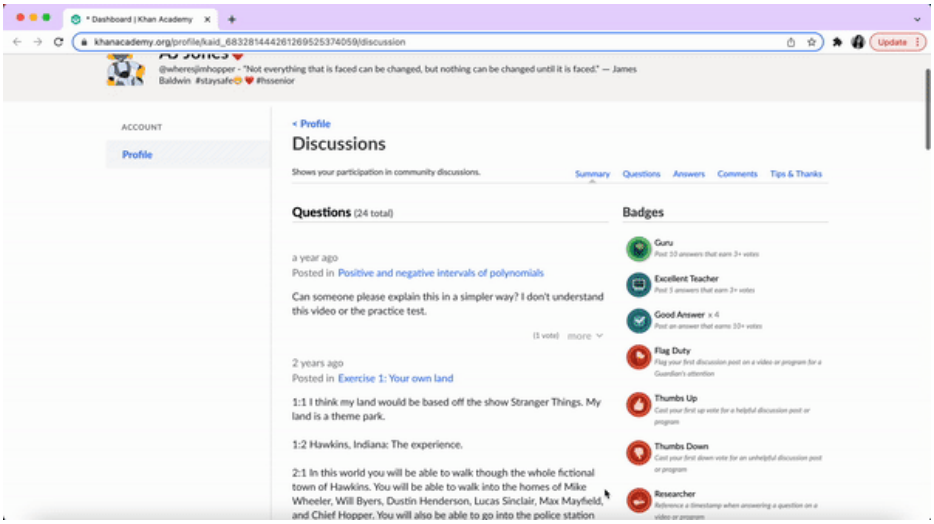
While at first the replies only consisted of other users agreeing with the statement 'Flora Baten' made, I also noticed that the replies also showed other learners building upon the knowledge that was being put out. One user, going by the name 'lilyrosethomas' expresses that only having one moral to a story is actually limiting as it makes the story only relevant to one group of people. Another user going by the name 'Righi' stated that morals can be found between the final stage of a character and its initial position at the start of the story.

These interactions where learners expand upon each other's opinion and added depth to the subject that they are learning felt particularly important to note. To me, these interactions show a process in which ideas are formed, thinking occurs and learning is socially constructed through indirect dialogues between the Pixar employees in the video and participants, and directly between one participant with one another. This observation seems to correspond to the knowledge building model that focuses on the cultivation of public ideas and theories (Chan and Van Alst, 2018).



Example of discourse based on 'Flore Baten', a responder

The last group of learners that I've identified in Pixar in a Box are more knowledgeable others (MKO). Originally, Pixar in a Box was designed with the intention that it is to be used by school-aged children. Trying to identify the presence of an adult or gauge whether or not the learner is a novice proves to be quite challenging. However, in the process of examining the profile of responders, I've come to notice that there are participants who disclose their identity in their profile. One example of this kind of user is 'AJ Jones', who discloses in their profile that they are a highschool senior. While the type of contribution 'AJ Jones' provides is similar to responders where majority consists of providing feedback to another user, the transparency of their identity as well as the badge that they earned as a 'Guru' in Khan Academy (counted by the amount of times their posts have gained +3 upvotes) is what led me to consider these profile as a MKO in this site. While it is hard to infer the impact these MKO can have in other learners' cognitive process, we could assume that other participants who might be engaging with these profiles and are curious enough to access their profiles will be able to see that they are engaging with a more competent peer.



Example of More Knowledgeable Others (MKO)

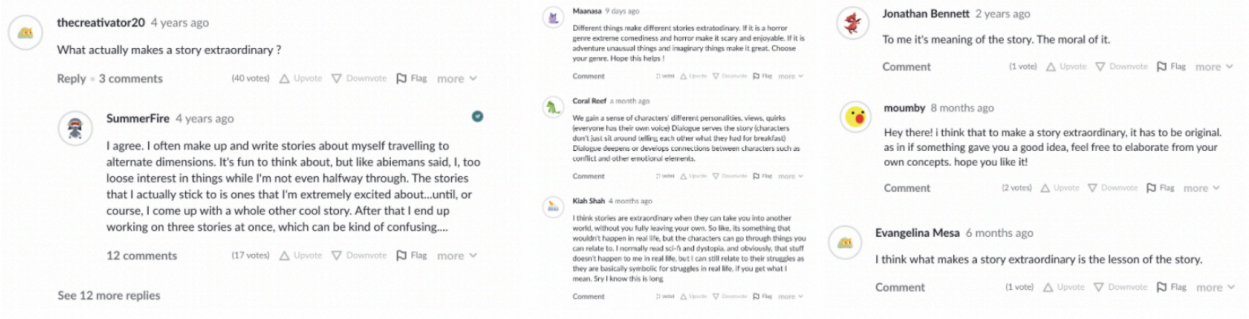
In the following section, I will be observing the relationship between the inquiries help seekers posted, its relationship and what it tells me about the process of learners engaging in problem solving activities and how the dynamics between the three types of learners interplays with one another in the knowledge construction process in Pixar in a Box.

Claim #4: Help seekers play a role in triggering co-construction of knowledge by posting content related questions that invite other participants to respond and engage in discussion beyond what was presented in the learning material.

Learning and knowledge building under the lens of social constructivism can have different meanings. Learning focuses on individual states, whereas knowledge building focuses on the construction of public ideas and theories (Chan and Van Alst, 2018). Having defined constructive behavior as instances where learners go beyond the course material in Pixar in a Box, a common thread that I've observed throughout my examples is that there are various ways a learner could go about externalizing their thoughts into the forum. In the following examples, I seek to observe discourses that began by a help seeker posting a question that invites other users to answer, and to try and understand what this tells me about learning.

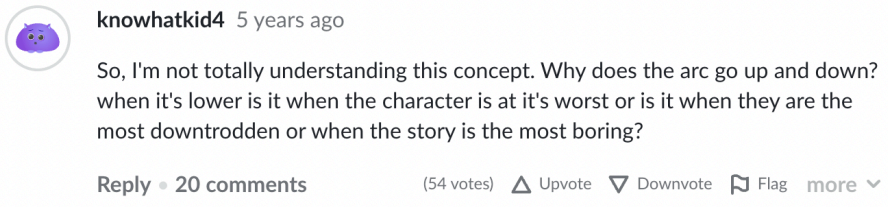
Help seekers can ask questions by: expressing their struggle with the guided activity, asking for advice or expanding upon the concepts that are being taught. For example, in an introductory unit about "your unique perspective", the accompanying video material talks about how everyone is a storyteller through their own experiences. Various Pixar employees shared about the different ways and moments when they first began sharing stories. The corresponding activity asks people to share their favorite memories. Two top voted threads from five years ago that are still gaining traction today start from one user that asks "what makes a story extraordinary?". In another, one participant seems to share their struggle by asking "How do you deal with the need to share a memory that feels very intimate, when you want to transform it into

a story?”. These two questions were particularly interesting to observe as it seems to paint a process of how people internalize new information. While understanding that everyone can be a storyteller, the user who asked about extraordinary stories seems to also observe how not all stories are equally engaging. In voicing their struggle, the user who asks about intimate memories seems to allude to a cognitive challenge one might encounter in carrying out a seemingly simple task (expressing one's' favorite memories may not be something that everyone feels comfortable doing). These questions ignited a discussion where people share their own inferences to the inquiry. In the extraordinary thread, one user responded by saying that extraordinary stories have to be original. Another said that extraordinary stories are dependent upon their genres - a horror story, it argued, “needs to be scary yet enjoyable”. Others in the thread mentioned factors such as having characters with different personalities, characters that people can relate to, ability to transport readers to a different dimension and providing morals or inspiration. Rather than a mutual agreement, the thread ended with a collective generation of various perspectives and accumulation of differences in meanings amongst users.



Example 1

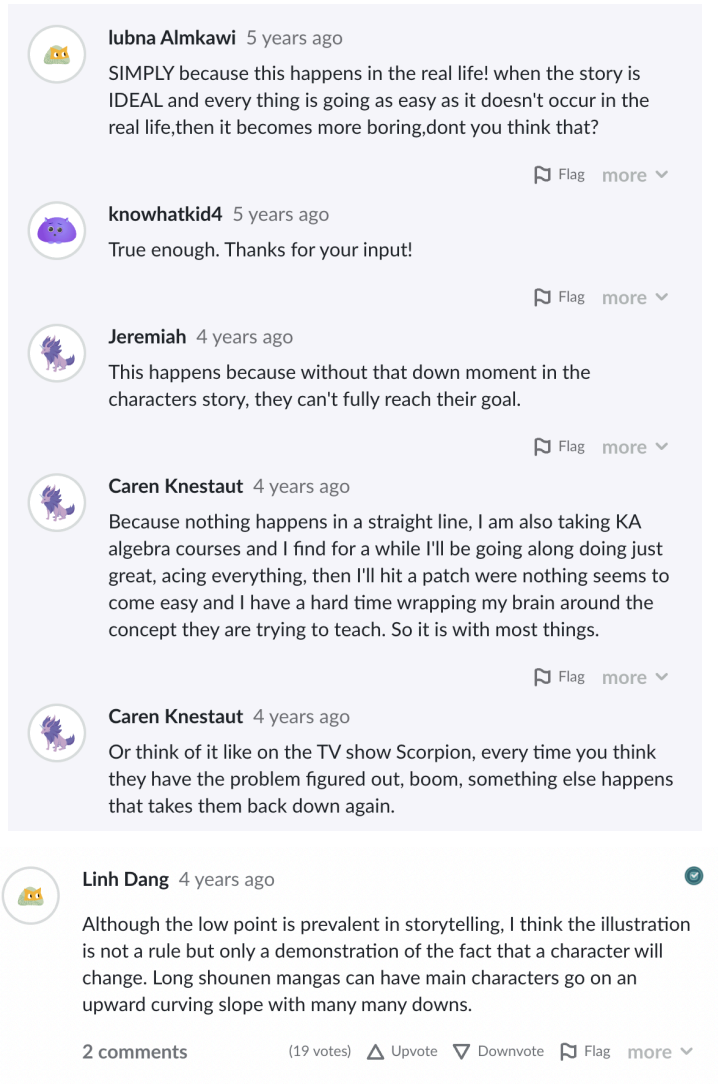
Another manifestation of this type of conversations occurred in a unit about story arcs, where Pixar employees visualized the arc as a rollercoaster in which the character goes through a series of ups and downs. In one of the threads from five years ago, a user who goes by the name ‘knowhatkid4’ expresses that they are struggling to understand the concept of the arc and what it represents. This post garnered 20 replies and 54 upvotes.



Example 2

In the reply, other participants chimed in by offering their own understanding of the arc. A top reply came from a user going by the name of ‘lubna Almkawi’, who expresses that the arc in a story basically represents what happens in real life; where nothing is ideal and that an easy

life will seem boring. The answer ‘lubna Almkawi’ provided created a springboard for other learners to chime in. Building upon the original statement, other learners began drawing the connection between nothing in life happening in a straight line - and how a character arc can be found in other school subjects such as algebra or in TV shows where the plot leverages on a ‘down’ moment before the character reaches their goal. The thread concludes with user ‘Linh Dang’ saying that the character arc presented by Pixar should not be seen as a rule of thumb, but rather a visual demonstration of how engaging stories are built upon a momentum of going through high and low points. There are stories, ‘Linh Dang’ pointed out, where a character can go through multiple ups and downs. I found this interaction particularly interesting to observe as it showed a process in which learners pull from different fields of study to help construct their understanding of the art of storytelling - rather than learning about the subject in isolation.



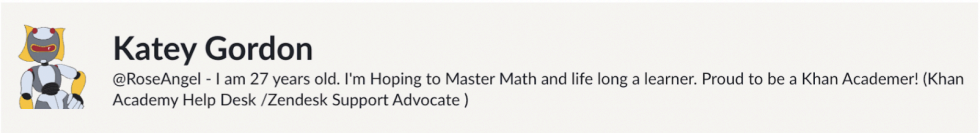
Example 2 (continued)

In short, the goal of meaningful learning (as opposed to rote learning) is to foster transferability of knowledge. While I am not able to truly observe examples where learners showcases their ability to apply what they learn from Pixar in a Box in a different learning context, I came to the conclusion that as a course and through its discussion forum, Pixar in a Box are able to facilitate learners to generate questions and come up with ideas beyond the course materials. The act of learning in Pixar in a box, isn't a one way street. Participants learn by negotiating between what they come to know and by engaging in knowledge building with other participants through textual dialogues. These dialogues do not come about naturally; but rather ignited by help seekers by posting questions and forming open ended statements.

Claim #5: Learners and more knowledgeable others function as co-equal agents in open learning environments. MKO can encourage peer learning without having to establish their positions to other learners.

The social constructivist lens postulates that the pairing of an adult and a child is more likely to promote cognitive growth. In the absence of an adult, a more competent peer can serve similar functions (Vygotsky, 1978; O'Donnel and Hmelo-Silver, 2013, pg.9). As I had mentioned, one of the struggles that I had in observing Pixar in a Box was to identify the presence of an instructor or adult in the threads. In the previous section, I identified users such as 'AJ Jones' who indicated their identity as a high school student and would respond to other users' posts by providing help or feedback, defining such users as More Knowledgeable Others (MKO) in the forum. Now, I will try to outline the dynamics between these MKO and other participants, and the role MKO can play in the cognitive process.

In scouring through the different pages of the community forum, I began to notice one user who is quite active across different lessons. At first, the username 'Katey Gordon' gave nothing away. When I clicked on its profile, the bio indicated that she is a 27 year old adult.



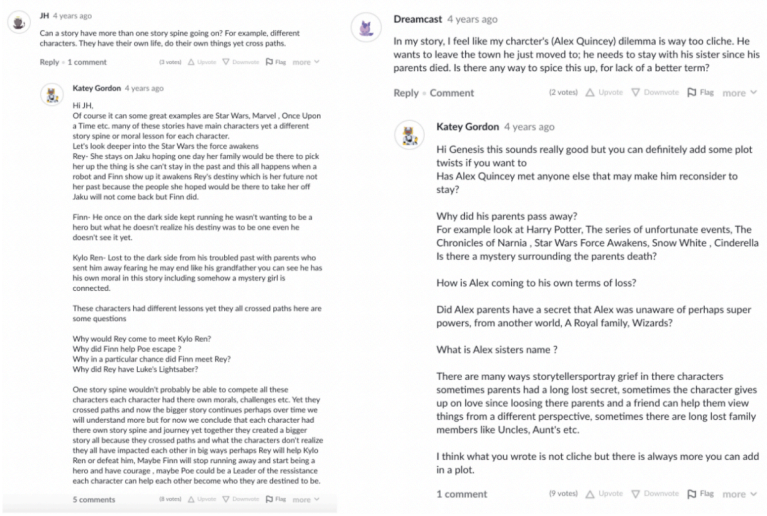
'Katey Gordon' Profile Biography

Interestingly, in her contributions to the discussion forum, 'Katey Gordon' never alluded to her age nor positioned herself as a more competent peer, choosing instead to comment as if she was another participant with her own perspective in the course. Yet there also seems to be a pattern in her responses that can be observed. Congruent with past observations for this particular set of users, 'Katey Gordon' responds mostly to posts where users are posting questions or asking for feedback.

In one example, 'Katey' responded to an inquiry made by a user during a unit on story structures. The user was asking if a story can have more than one story spine. 'Katey' replied by

saying that it is indeed possible, and referenced popular movies such as Star Wars and Marvel as an example. ‘Katey’ then proceeded to invite those who are reading their post to unpack why Star Wars is a good reference, detailing the different arcs each character in Star Wars have and how it contributes to the larger story. ‘Katey’ concluded the post by pointing out that the most important part of a story structure is not the amount of storyline it holds but how everything comes together cohesively.

In another, ‘Katey’ responded to a user who was asking for feedback on how to spice up an idea for a story that they had. The initial post was very straightforward: the asking participant was worried that their idea seems to be quite cliched. ‘Katey’ began their reply by saying that the idea is a solid place to start; then asks questions to better understand the thought process behind the original post (“why did that happen?”). ‘Katey’ referenced Harry Potter to illustrate their feedback, and concluded by saying that what the user wrote isn’t cliche but there are still opportunities for refinements.



Example 1

Katey Gordon’s responses tend to be well articulated and full of constructive feedback. The tone is encouraging in a way that she is supportive of other learners while still giving room for improvements or food for thoughts. In other instances where ‘Katey’s’ replies aren't as elaborate, it still contained practical tips. Such is the series of examples below, where Katey responded to other users who were asking questions regarding pitching ideas, pacing a story and whether or not it is necessary for a story to have a resolution. In responding to these inquiries, ‘Katey’ provided practical tips, maintained an open minded tone in her texts, often referring to her own experiences or popular movies as a form of example. Although it did not initiate further conversations within the thread, almost all of Katy Gordon’s posts that I’ve observed have always either been upvoted or replied with a ‘thank you’ by other users.

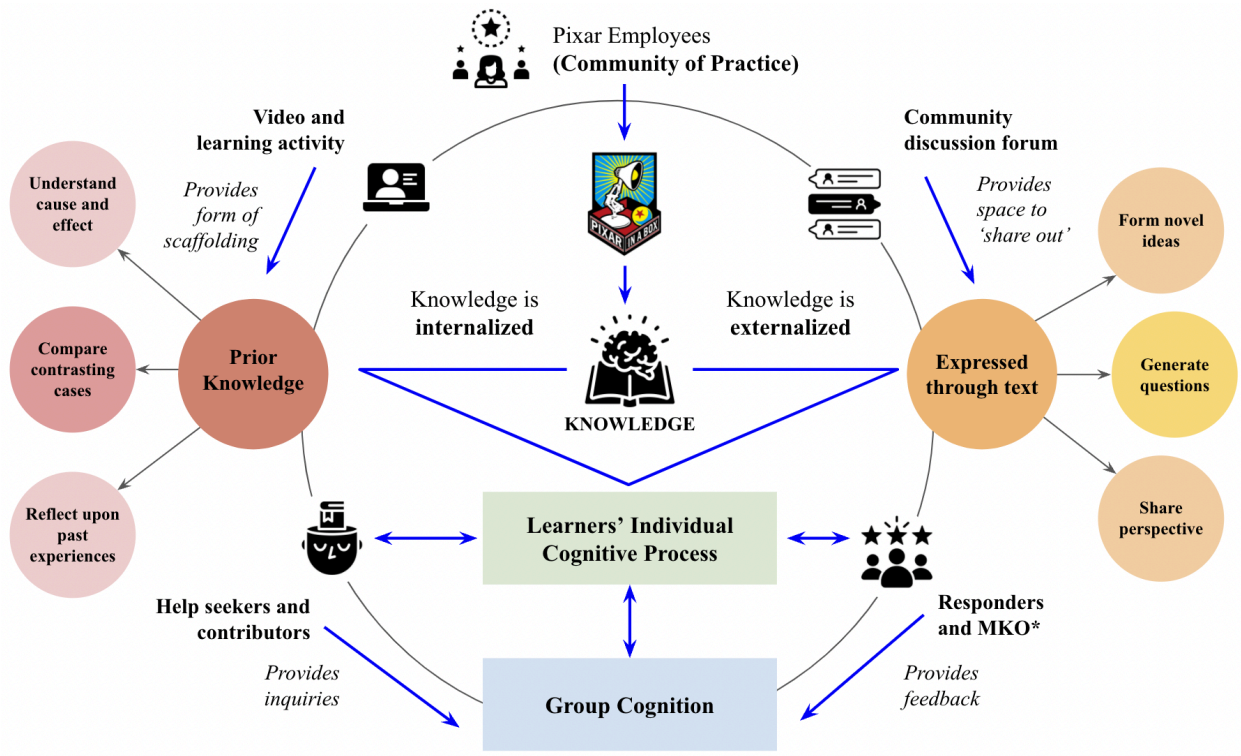
Example 2

In traditional learning environments, different power structures and clarity over roles meant that the relationship between a learner, more competent peer and teacher are easier to observe. One of the rules in the Khan Academy discussion forum is that everyone is expected to become 'be a guide' and become 'each other's teachers'. Perhaps this is why MKO does not necessarily need to establish their status amongst learners to provide support, becoming equal agents in the learning process. By providing constructive feedback, MKOs plays a role in the peer learning process, and by extension, became an extension of the Khan Academy and Pixar in a Box experts who are only present in the video through the learning materials.

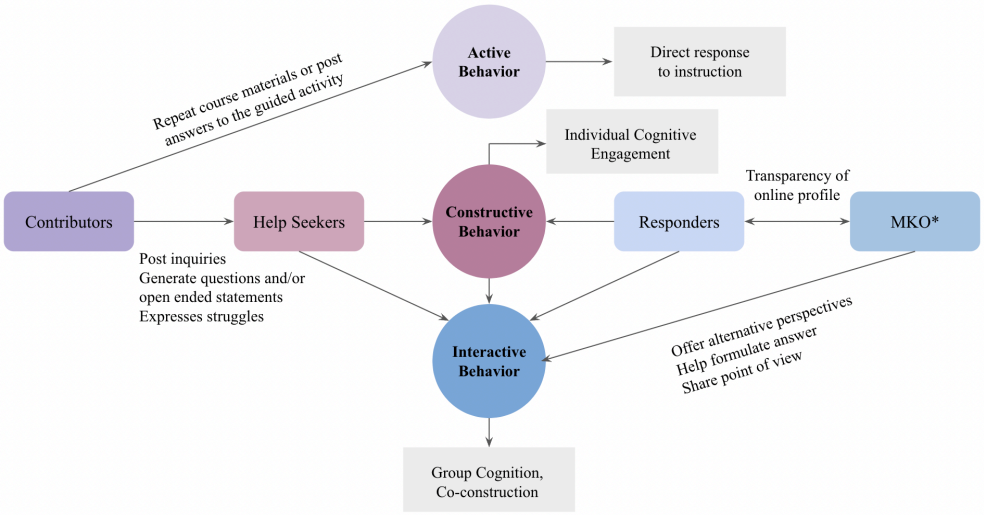
Conceptual Framework

Putting everything together, there are two conceptual frameworks that I've developed. One to illustrate how my interpretation of how knowledge, and the process of knowing (or learning) unfolds in Pixar in a Box based on my observations. The second is to illustrate how I see the relationship between the learning behavior and types of learners that I've identified.

To sum up, learning in Pixar in a Box begins with knowledge from industry experts (Pixar employees) being scaffolded into the MOOC in the form of chunkable modules and activities. The learning material, guided activity and discussion forum together becomes a technological artifact that learners can leverage on to construct knowledge. As learners engage with the course, knowledge is internalized and connected to prior knowledge or experiences. These coming to know processes and personal interpretations are then externalized by learners as they express ideas or justify reasons. Contributors and help seekers externalize knowledge to help them construct a better understanding of the subject they are learning. Their posts can come in the form of an inquiry, a statement or an invite for other users to share their opinions; thereby playing a role in group co-construction of knowledge. In contrast, responders and more knowledgeable others (MKO) contribute to the forum by providing constructive feedback and alternative approaches or ways to think about the task at hand. Both types of learners engage their individual cognitive process to contribute to the group cognition. The different types of learners function as co-equal agents in this group cognition process. This process is circular, and the circle in the framework represents the infinite temporal period in which these relationships can take place as well as the longevity others have to access the discourses.



Zooming into the bottom part of the framework, this is how I see the relationship between individual vs group cognition and learning behavior that can take place in the forum.



Reflections

There are two things that I knew for certain coming into the project; that I was drawn to Pixar in a Box for both personal and academic reasons, and that I wanted to take on a social constructivism lens as I have always been a proponent of collaboration. What I did not foresee was the degree of complexity in observing learning based on a digital space, and the different

dimensions that have to be considered when looking at learning as a social activity. In the beginning, everything felt very scattered, and I wanted to come into my observations as a Traveler (rather than a miner) but this was easier said than done. I would look at the discussion forum, scroll through participants' comments, capture what they posted and keep asking myself "does this count as evidence of learning? How is this valid evidence?". It quickly became apparent to me that the initial research question that I had to focus on interaction in the forum; while reflective of the social constructivist perspective - was too specific and only reflected one side of the whole lens. This was made even challenging given the fact that MOOCs, by design - does offer a space for social learning, but not all social interactions in a MOOC can be considered a learning interaction. In undertaking this project, I now understood the different nuances one has to take into account when looking at 'collaborative learning', and that to truly judge learning from a social constructivism lens, then one must look at both individual and group cognition; as learning is what happens in the intersection between the two.

As such, the first learning curve that I had to take on was to change my research questions; refining my focal points of interest so that it is broad enough to help me identify different perspectives of social constructivism and where I could see learning happening; but also specific enough that I remained focused and not get lost in the endless list of online conversations. Two things that I found most helpful during this process of refining my questions and in going further into my observations was to refer to the readings that we had but also to look out for past literature on research about learning in MOOCs. Not all of what I read was applicable to my observations; for example, I found that a lot of the literature that I read was based on a MOOC that does not share the same design as Khan Academy. In some of the MOOCs, learners' drop off rate could be measured, or the research was designed in such a way that the authors could investigate the degree of transfer of knowledge from a pool of participants. Both were something that I was not able to do with Pixar In a Box. However, by reading through these different materials, I was able to grasp the different approaches one could go about observing MOOCs. This gave me a new understanding in re-reading the course materials that we had and to apply the framework that we learned into my own methodology. The readings by Brinton et al. (2014) and Wise et al. (2017) on approaching learning in an online discourse were particularly helpful; not only to help guide my purposeful sampling but also in selecting evidence for the claims that I eventually made. The classroom activities, and how it was structured (going from constructivism - constructionism - social constructivism - situativity) was also useful as it helped me connect the dots between the lenses in parallel with doing my observations. I felt that once I was able to identify how the different lenses come together, I had a better idea of how my memo set, claims and eventually conceptual framework had to expand.

Part 3: Group Synthesis - Putting It All Together

From the beginning of our observation, it was clear to us that both of our lenses work in tandem and are complementary to one another. The lens of constructivism focuses on the individual as a learner and how they are active participants in their learning and knowledge

construction process. This was a contrast to previous views on learning who sees the learner as someone who is passively taking on new information. The lens of social constructivism expanded on this to include that knowledge, as much as it is about the individual, is also constructed by the ways in which learners engage with others, their community and the world around them. Thus, the tensions that we've observed do not necessarily stem from the characteristics of the lens itself; but in the factors that affect how these lenses are observable in our site. Having said that, we realized that there is a subtle difference in the way both of us conducted our observation; for constructivism, the focus was more on the relationship between the learner and Pixar in a Box as a learning site. The claims that were made under the constructivism lens focuses on the process in which learners came to make sense of their own progress and challenges in learning based on how Pixar in a Box designed its course. These claims help inform design decisions and possible recommendations in which Pixar in a Box could be improved in terms of learning experience. For social constructivism, the focus of the observation was on the intersection between individual learning experience and group cognition that was analyzed through the discussion forum. Dynamics between participants, as well as the types of behavior that they exhibit or the ways knowledge is expressed in the discussion forums plays a central role in the claims that were made under this lens.

To sum it all up, we believe that the relationship between our lenses can be viewed as a spectrum. On the far left of the line is instructionism, where knowledge is transferred by experts to learners. While this isn't necessarily the ideal way to learn, instructionism is inherently embedded in MOOCs due to its top down nature of learning materials. Moving to the middle of the line, we have constructivism, where learners' constructed self discovery process takes center stage. At the end of the spectrum is where we have social constructivism, and this is where learning becomes more social and contextual. Here, the knowledge that has been constructed by the individual is either restructured or reinforced by the presence of multiple perspectives.

One key discussion that we had in our attempt to connect our lenses is the idea of collaborative technologies, and its role in providing scaffolding in the form of knowledge experts and online support (Hannafin et al., 1977, Driscoll, 2005). In both constructivism and social constructivism, the presence of experts and feedback are important factors that help people learn. On one hand, online learning like Pixar in a Box empowers learners to gain insights and knowledge from real-life professionals and gain deeper understanding of a specific domain. However, the asynchronous nature of these learning environments also means that it lacks the opportunity for learners to gain feedback from these experts. The presence of MKO to help scaffold this process, as well as the findings that Pixar employees did contribute to the discussion in the forum during the early stages of the course made us wonder how the learning experience in Pixar could have been different then compared to today. While considering the potential differences in the learning experience, a discovery we stumbled upon while conducting our observations is that it appears that when this learning experience was initially launched there were experts/knowledgeable who functioned as moderators who helped with responding to learner questions, inquiries, comments etc. in the discussion boards. We saw multiple instances

in posts of over five years ago where a learner would pose a question and somebody would reply with an elaborate and insightful response. Upon further research and clicking on the user profile, we found certain users included in their bios that they worked on Pixar in a Box and had earned multiple badges such as “incredible teacher, guru, sensei, guardian, etc” which were all accredited for their contributions to discussion boards.

Part 4: Recommendations & Future Work

During the course of our observations and in the synthesis that follows, there were a few challenges that remain unsolved, either due to lack of evidence or by virtue of how Khan Academy designed its platform:

Learners drop off rate and motivation to learn

As observers, we were not able to see the total number of participants engaging with Pixar in a box; nor were we able to see where learners started dropping off during the course. The only way we would be able to gauge this is by manually accessing the profile of learners who contributed to the discussion posts to see whether or not they made other comments. We felt that being able to see learners’ drop off rate would have been useful to measure learning outcomes of Pixar in a Box. As it currently stands, the only evidence of learning that we could observe is limited to what people express in the forum. Given access to this data or by way of furthering our investigation, we would be curious to explore:

1. How did learners come about choosing which courses to take in Pixar in a Box? Do learners come in with the expectation to complete the full course, or are they drawn to specific learning units? What/how would these motivations differ and how did it impact their learning experience?
2. What are the factors that would drive learners to drop off from Pixar in a Box?
3. How does learners’ drop off rate impact transfer of learning?

Authentic tasks, feedback and opportunity for additional scaffolding

We noted that there was considerable evidence of scaffolding embedded in the Pixar in a Box learning environment. However, having said that, there are limitations that we observed. For one, from the way it is currently designed, much of the scaffolded activity lacks the opportunity for learners to gain real-time feedback. There is also no certain guarantee that learners will receive a response to their posts, as this is very reliant on the presence of another user to decide whether or not they’d like to respond. Considering this, some questions that we feel are worth investigating:

1. How do we make sure that learners are able to gain feedback?
2. Is there a relationship between the quality of feedback on learners’ coming to know and knowledge construction process?

Considering this, one recommendation that we feel can be considered is the opportunity to provide additional scaffolding, especially one that provides learners with opportunity to receive feedback. Perhaps by doing so, learners will be motivated to contribute more novel ideas and authentic inquiries in the discussion forum (as opposed to only responding to the guided activity) and thus be able to have a more enriching learning experience with Khan Academy. Another potential recommendation for scaffolding would be to provide hyperlinks to other content available in other courses in Khan Academy where more novice learners could take a deeper dive into the more complex concepts. For example, as seen in one of the constructivist lens observations, when a learner needed additional support another learner scaffolded by paraphrasing and included a link to help further extend the learner's understanding of the content. Khan Academy is a platform with an immense archive of content, linking relevant concepts across courses could be beneficial and an easy way to help deepen understanding in an efficient and seamless way.

Evidence and role of artifacts

In relation to our previous recommendation, another recommendation that we would like to propose is for Pixar in a Box to have the option where learners are able to not only comment or explain, but also upload pictures over their output. Some of the guided activities that Pixar in a Box crafted involved learners having to conduct offline activities, i.e. lighting experiments involving the lamp and objects learners have at home. We feel that these types of activities are an interesting form of scaffolding, but as observers, we cannot actually see the end result. This was also a sentiment that some participants of Pixar in a Box commented on the discussion forum. Perhaps by allowing learners to submit their art work, or conduct other activities such as drawing, there will be more artifacts that participants can leverage on (and us to observe as researchers) to aid their learning process. That would create an opportunity for a wider variety of learning output that could potentially be evaluated apart from comments and statements which could result in higher levels of engagement and motivation for learners since there is potential to receive feedback on learner products and a more accurate/tangible way to assess learning and understanding.

Bearing in mind that our analysis is conducted on one learning platform, there are various ways this research can be expanded in the future: one, by analyzing and contrasting other courses in Khan Academy to see if the patterns and claims we found still hold true. Secondly, a further expansion would be to compare learning in Khan Academy over learning in another MOOC platform. Doing so might help inform better understanding of how learning takes place in an online space and the design decisions that need to be considered to create an authentic and enriching learning experience. Lastly, it would be interesting to observe this same learning environment through alternative theoretical lenses such as constructionism and situativity and to consider how different the questions and insights that would arise would be when observing the same learning site through different lenses.

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