ELC 064: How to Create Meaning From A Torrent of Information

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Connie: Hello, learning people, and welcome to episode 64 of The eLearning Coach Podcast. Every day, we engage in sense-making from a torrent of information. And we attempt to help others construct meaning in the learning experiences we design and provide. But what if we had a better understanding of how people create meaning as they interact with the world? Would that make you better at what you do? I hope so, because this is the subject we delve into in my conversation with Karl Fast, the co-author of Figure it Out.

Connie: Karl holds a PhD in Information Science and is a former professor of User Experience Design. As a writer, he explores how information shapes the human experience. Karl has worked on complex information problems across startups, space science, internet, education, and Fortune 500. We discuss how the science of mind is evolving, how to broaden our assumptions about learning and thinking, to include embodied cognition. And we look at a specialized vocabulary that describes the processes and interactions we use to help us figure things out.

Connie: You can find the show notes and a transcript at theelearningcoach.com/podcasts/64. Here's our conversation. Hi, Karl, welcome to the eLearning Coach Podcast.

Karl: Thanks for having me, Connie.

Connie: I'm looking forward to discussing the book that you coauthored with Stephen Anderson, *Figure it Out*. To start off, can you summarize the thesis of the book?

Karl: It covers a lot of ground. I would say that we've got three major strands that are involved in the book. One of the big ones is that information is changing. Not only do we have a lot more information, but we have information as much more pervasive. In our life, information is just in every nook and cranny of her life. It's not something that you go to, it's simply something that's there. It's on your wrist. It's in your pocket. It's everywhere.

Karl: And we're asking information to do more and more. We want it at home, work at play, all aspects of our life. We're becoming more and more dependent on information. It's becoming more complex. But we also know that the technology along with that is changing, and it's becoming more ubiquitous, and it's becoming more interactive.

Karl:	And then the third strand I could talk about here is that the science is changing, right? The science of how the mind makes sense of all this information. One of the big motivations for the book is in some way to try to bring these kinds of things together, and particularly bring it together for people whose work is about like, "How do I design the world? Designed for a world with this kind of information." Not just to deliver it to people, but to make that information as useful as possible for the many, many different ways that it's going to be there.
Karl:	And I can talk a bit more about that because we've had this long-standing assumption like well, computers, information, keyboard, mouse, sitting in a chair. And mobile has totally changed all that. And that is going to continue to change. The trend lines are very, very clear. But the whole conceptual toolkit we have around how the mind works, is based on how the brain works. And equating those two things together, really downplaying the role of our bodies, downplaying the role of interaction, really minimizing it.
Karl:	And so, as our technologies continue to improve, we're going to need to begin rethinking some of the basic conceptual tools we have for designing interactive, designing our digital systems for how we can use this information much more effectively.
Connie:	So, even though this episode is mostly about interactions and embodied cognition, can you talk about some of the other themes that you address? Because there's an unusual blend of topics.
Karl:	We talk about understanding, and we have sort of four major things we talk about. We talk about associations and how the brain makes associations, how the associations in the world can trigger associations in the brain. We talk a lot about representations, especially external representations in the world, especially visual representations. And then the third major section, which is the focus of our interview here today, is the piece around interaction, how we interact with representations and how that could create new associations, and how all that fits together.
Karl:	And then the last piece of it is how we take a bigger step, what we call coordination, and how we bring all these different kinds of things together. And that takes a broader view.
Connie:	Mm-hmm (affirmative). You write that information is a resource, what do you see as the advantage of changing our perceptions to look at information in that way?
Karl:	So, we talk about information as a resource in the book, because, I think a lot of times in our society, I had this idea that information should just be given to us.

And when it's given to us, then it should also come along with understanding. But that's not really the way that it works. We often have to go and dig around, get information, pull out little things, link it together. We often need to create understanding on our own, to think about the difference between wheat and bread, or between iron and steel. By taking it as a resource, we can use it to create other kinds of things with it.

Karl: In this sense, we view information the way that say the maker movement views lot of the things that we have, a lot of the prepackaged commodity goods. Makers don't like to say, necessarily, buy everything. They want to customize things. They want to tinker with things. And I think that this is an interesting way that they can shape and reshape the world. And information as a raw material becomes very powerful.

Connie: It did change my perception of it when I read that chapter. It just made me more aware of what I'm doing with the information, and how when I come across something that I can't understand, it made me feel more hopeful and optimistic that I can manipulate it, and eventually understand it. Manipulate it in some way to make it easier for me.

Karl: An example is like you get PDFs and you've got an iPad and/or get some tablet and you can mark it up, or you print it out and you mark it up. That's an example of using it as a resource. You're not just reading it and taking that information and have it going into your brain, you're doing something with it. And that doing something with it, if you've ever highlighted a text, is part of how you're treating it as a resource to gain understanding from it.

Karl: I've been using a little bit a PDF app called LiquidText. It's a novel tool for working with PDFs, and allows you to select things, grab pieces out of it, link them together. And you build basically... You have the document on one side, and what they call a workspace on the other side. And you're not just selecting pieces of information from it, you're pulling it out, you're copying it, you're connecting together, you're adding notes. And so, you're constructing this separate document on the right-hand side, which reflects your understanding of the information that you had.

Karl: And that is a very visual result that you get. It's a very interactive process, and it's a different way of looking at the information that we have in our lives. And this becomes especially important when you're taking on more complex problems, when you have more complex information, or when you've got lots of different information as well. I mean, you're pulling in real information from all kinds of different sources. How do you stitch that together? Rather than thinking of this

one, document, this one video, as the key source of truth and the only thing that you ever actually.

Connie: It's like we're self-curators. One thing that it makes me think of in terms of learning design, is that we could do more as learning experience designers to encourage participants and learners to do some of this on their own, so that they become better at self-directed learning. You know what? It reminds me of that website Hacking IKEA.

Karl: No, I hadn't made that connection, but as someone who has lived, in the last 15, 20 years, six different cities across three states and three provinces, I have made many trips to IKEA, and I've had to solve many different kind of organization problems in all these different places of living. And I've done a lot of IKEA hacks. And so, yeah, you can go to IKEA, and you can treat it as like, "Okay, this is a finished product, and I have to do the assembly." But IKEA hackers look at it as, "Oh, well, all this is basically a resource where I can mix this together with that other thing. Or I could cut this in this particular way."

Karl: I particularly like to get some of the cheap pine furniture from them. Because if it's wood, as opposed to the particle board, it's really to cut it. Then if you cut it, you can re-sand it and stain it. I got a little side table. It's under my desk right here. I cut down the legs, I cut down the top, I finished it, and it makes a perfect printer stand with a big drawer and a slot for paper.

Karl: It doesn't work as a printer stand if I just didn't do anything to it. But by thinking of it as the possibilities of what I could do with it, rather than this pre-packaged final good, the world is something that we can make for ourselves. Mad when we do that with information, we create new kinds of understanding. And this is often a very physical, tactical, interactive, kind of process.

Connie: And that's basically what the rest of the book is about?

Karl: And that's why it's called *Figure it Out*. My co-author, Stephen, is the one who came up with the title. And he went through and came up with a whole bunch of different titles. Some of them I liked quite a bit, but then he suggested figure it out. And what struck me is, after he came up with that, how many times I will use that phrase, figure it out, for solving some kind of problem. My son, he'll be like, "I want to know how do I..." I'm like, "We'll figure it out." Because if you do this, and you treat the materials you have at hand as something that can be manipulated and changed, and through that transformation, through that process, you will come to a better understanding. That's what we're talking about here.

Connie:	And that completely matches up with learning. If you give people something that's challenging, not so challenging that people get horribly frustrated and demotivated, but just the right amount of challenge, will help people become better at the skill. Because they have to figure it out. And that causes all these connections. Right?
Karl:	Right. Well, and it's well-known and learning circles that if you make learning too easy, then the result is shallow learning. You need to have enough of a speed bump. One of the ideas, I think, that we have, and we try to point to in the book here, is when we like to say that information is given, but that doesn't mean that understanding has given. In fact, quite often, understanding is not given. In a lot of cases, we need to create information for ourselves. Or, I create the understanding. And the way that we do that is by treating information as an incredibly critical resource that we have at our disposal.
Connie:	Right. How do you define understanding? How do you think of it?
Karl:	We mean it here. Not in the sense of, say, the meaning of life, or understanding the nature of existence. We mean it in a sense of, every day, I have information, I need to use this, I need to accomplish something, I have a goal, I either understand it or I don't. We talk about it more, and we mean it much more in the terms of utility.
Connie:	Sure.
Karl:	Do you understand it enough that you can move forward, make progress, move closer towards your goals, accomplish the kinds of things that you're trying to achieve.
Connie:	And interestingly, there's this intuitive sense that when you do understand something it. You have that aha moment like, "I get it." So, you've made some kind of connection, and you can go forward with it. It's a good feeling when you have it.
Karl:	Yes. You might misunderstand, but as long as it's useful, that's okay. Right? That's sort of the take that we're looking at here.
Connie:	Can you briefly talk about how the science of mind is evolving?
Karl:	The science of mind is one of the big planks that we have in the book, or one of the main pillars of it, and how our science is changing. Going back to the late 1950s, there was a work that was done to overthrow a previous idea of how the mind worked. And that previous idea was behaviorism. The idea of behaviorism

was that the mind is a black box. All that we can really know is the behaviors. There are inputs and there are outputs. This is BF Skinner and the Skinner box. And so, you have operant conditioning, but with the mechanisms of mind, that was just unknowable.

Karl: And cognitive science emerges in the late 1950s by saying, "Hey, that's prom." We can absolutely, through some careful clever experiments, begin to unravel at least some of the ideas of how the mind works. And this led to, over the years, especially through the sixties, seventies, and eighties, what was originally called the information processing theory of mind and as the computational theory of mind.

Karl: The big book on this subject that's for a wide audience is Steven Pinker's book, How the Mind Works. Just written the late 1990s. And is an excellent, just an excellent book. And the idea of that is that we perceive information through our senses. And all of this is transformed into electrical signal, so it should make their way into the brain. The brain then converts these into what we call mental representations, and the brain does mental computation on those. It doesn't do computation the way that the computer does computation, but it does operations on this information in the brain. And that is what we call thinking. That is what we call cognition.

Karl: And so, the computational theory of mind is really focused on this internal mechanism, and equates, for the most part, mind with brain. So, you have perception as input, we have cognition is what the brain does. And then action is viewed as output. And you have models of mine that were developed in the 1980s and later, which are really very rooted in this idea.

Karl: You will see these models of mine in which there's no feet, hands are manual motor processors, eyes are ocular motor processors, and it's a very mechanical kind of thing. You especially see this kind of thing in human-computer interaction, where people who are trying to develop computer interfaces, where the assumption was, you're sitting down at a desk, with a keyboard and a mouse. So, why would you create a model which includes the feet?

Karl: And then of course, we get smartphones. And now we're getting computers, and our information technology is embedded into every aspect of our life. And mobile is really, really important. So, then what happens starting in the late eighties? You get a lot more people saying, well, wait a second, if we do this study or we do this kind of thing, we find this thing where there's more going on the body, it actually begins to account for things.

Karl: Let me give you a simple example of a study. They did a study with having people play Scrabble. They have two groups of people. Each, they get a set of Scrabble tiles. So, you've got seven letters. And they're asking, say, two minutes, to come up with as many different word combinations as possible. Group A is given exactly the instructions that I gave just now. Group B is given the same instructions with one additional thing, you can't rearrange the letters, perhaps to sit on your hands.

Karl: The group that was not told to use their hands, naturally reaches out and begins picking things up, naturally begins moving around the tiles. And that rearrangement of the tiles, by putting two letters next together, triggers certain kinds of associations, trigger certain kinds of ideas. And now people wind up in that particular condition, created way more word combinations than the people who couldn't use their hands.

Karl: The people who can't use their hands do something else though. If you watch them, they do move their body. They will move their body in and kind of nod their head. Okay. Like, I can move this, and I could move that. They bring their body into it even when they're told that they can't use the most useful part here. So, these and many other kinds of studies began pointing out that maybe the body is a little more important. And this led to this idea of what we call embodiment.

Karl: The Scrabble study isn't the key study here, it's just one example. There's a whole host of different studies. And over the last 30 years or so, there's been a growing body of evidence, which makes a variety of different claims, but this all goes under this idea of embodied cognition.

Connie: And embodied cognition makes so much sense to me. We were talking earlier from watching children how they learn, how they think. But also, just the way using gestures helps us communicate, even when we're alone in a room, it helps us bring speech forward.

Karl: There's a woman at University of Chicago, Susan Goldin-Meadow, who has done... Basically, her whole career has been around why do we use our hands when we talk? Why do we gesture? A reasonable answer, we're used to talking with people face to face, so it's a learned behavior. When nobody is there, it just kind of carries over. Reasonable answer.

Karl: So, next question, why do people who are blind talk with their hands? And why do people who are blind talk with their hands when they are talking to someone else who is blind? And both people know. So, you have two people who know that they are talking to someone who has never seen a hand, and they're both making hand gestures. And there are studies where they've given, say, sighted

children and blind children reasoning tasks. Ask them to do this particular problem and then explain their reasoning. And not only will both groups give hand gestures, they will give very similar kinds of hand gestures to explain their reasoning.

Karl: The conclusion of her research, over 25, 30 years, is basically that, yes, there is an important part of why we use hand gestures that is outward facing, that is directed towards other people, as to enhance communication. But there is also an important part of gestures that is inward facing. That by using our hands, we are actually making it like a cognitive grease. It helps loosen things up in the mind. You can see this in conference or a panel discussion. Somebody will ask a question of the panel, people will be like, "Oh, I'm not really sure." And then they start moving their hands. And the words will kind of start to tumble out.

Karl: That's an example of this idea of embodiment. And that there is a deep connection somehow between mind, body, and world. What the science is trying to do is trying to piece this out. What is the nature of it? How does it work? How significant is it? And how does this change the way that we, for me, great question in this book, at least in large part is, how do we combine that with information as a resource to reshape how we can think about the information we create and the tools we use, and we create to work with information?

Connie: Mm-hmm (affirmative). So, this is the basis for understanding interactions. To understand how interactions shape our understanding of the world, we need a definition of interaction. Do you have one that you can start off with?

Karl: Well, the definition that I like to use is that, interaction is action on the world, coupled with the reaction of the world.

Connie: Okay.

Karl: There's a subtle aspect to that, that I really feel is necessary to draw. Because it seems like an almost an intuitive definition, action and reaction. But know that there's a difference between action and then reaction, which just I think are the way that most of us would define it, versus action coupled with reaction. There's this connection between. What interaction does is kind of begins to glue. It acts as kind of... I think that was a kind of a cognitive glue between what the brain does, and how we put some of our thinking out into the world, and how we use the world as part of our thinking apparatus. So, that's how I tend to think of interaction. It's the world and the bringing these two things together.

Connie: Yeah. It's abstract, and yet it feels so real.

Karl: It draws one's attention to longstanding assumptions that we have about what we believe to be true raise us up things that we have discounted or ignored for a long time.

Connie: When we're talking about interactions, you are talking about epistemic actions. Can you quickly just explain the difference between pragmatic and epistemic actions?

Karl: Sure. When it comes to interactions, we tend to have a very narrow view. And I mean, even academics have a relatively narrow view of what action is for. Why do we act on the world? Why do we physically move our bodies? Right? It seems like a very simple question. There's a paper from a decade ago or so called the Science of Interaction. What they point out is like, "We don't have a theory of action." When we design interactive systems, we tend to think that more movement, more action, is actually a problem.

Karl: In my area, in information architecture, we do a lot of work around organizing large amounts of information and creating, say, navigation systems. You go through a navigation system in our website and we'll do a study called a Treejack test. On a Treejack, you'll have this big hierarchy, and you'll get people just, not all the details, but you'll just create the hierarchy with all the different labels for the hierarchy. And you'll say, "Okay, if you were looking for this information, where would you go?" And we'll record.

Karl: The general rule of thumb is, well, the more people who can go immediately to a particular place in the hierarchy, the better the design. In other words, going anywhere other than the best path, the most obvious path, the fewest clicks is the best as though every other click is a mistake. The best path is the optimal path that would lead us to the best design.

Karl: But what if going down those extra paths actually is beneficial? One example here is thinking about how people play chess, right? You've got a bishop, you pick that bishop up, you move that bishop into position, but you keep your finger on it. And then you think, "Oh, that was bad move." So, then you move it back. And two things, you move something, and then you press undo, the world is unchanged. So, you shouldn't have done it.

Karl: But clearly, that's beneficial, especially for the novice chess player. Because the point is that you change the world to gain information about what the world might look like. You could have imagined that. An expert chess player can imagine what's going to happen when they make a bunch of different moves, but not as the best chess players can, so they physically move the piece. And then they're like, "Oh yeah, that was a bad thing."

Karl: So, to explain this, the researcher said, "Hmm, we can only explain this by saying that there must be some other benefit to doing these actions." So, they made a distinction between two types of actions. The first type of action, they called pragmatic. The point of a pragmatic action is, you change the world for the point of changing the world. I am thirsty. I would like to quench my thirst. So, I pick up a glass of water, and I bring it to my lips, and I take a slurp. That is a pragmatic action. If I dump the water all over my shirt, that's a mistake. I changed the world, but I wound up with the world changed in a way that I did not desire. That's clearly a mistake.

Karl: But an epistemic action is totally different. You don't take epistemic actions for the point of changing the world, you take those actions for changing your understanding of the world. So, you do it to make the mental work that you do, the work that you might do just alone in your brain, simpler, or faster, or to reduce the chance of making a mistake, to make things more reliable.

Karl: And that kind of thing helps us explain stuff like, say, to some extent, the hand gestures. Why do we make all these extra movements with our hands when we're talking? It's totally seems to be extraneous. We're doing it because it's beneficial. It helps what the brain could, in theory, do alone by itself, but can do better when we move a body, better when we interact with the world in some way. So, it's epistemic as in epistemology, as in, of, or relating to knowledge and how we know things, and how we create knowledge.

Connie: And also, I see a difference in your examples between the goals.

Karl: Yes. And I think with pragmatic actions, a lot of it is that there is often a fairly clearly defined end point. You have a desired state of the world, and either you achieve that state of the world or you don't.

Karl: But with an epistemic action, you don't always necessarily know if it's going to be beneficial for you or not, or if it's going to give you what you need.

Connie: It's a little experimental.

Karl: Yes. We're playful. And like we talked about kids before, right? And how kids use their bodies naturally to learn, this is something that's true in Montessori education, you don't necessarily take these actions because it's always going to give you something correct. Right? Always going to be useful. But without that playfulness, without that, it's the whole premise of Montessori education as that physical moving around and doing things, has a huge benefit to learning.

Connie: I mean, a child almost can't sit still. You see those kids bouncing in their seats. They need to move.

Karl: They need to move. Or, there are so many different types of things that you need to do by doing it.

Connie: Yes.

Karl: Well, we talked about IKEA furniture. So, think about getting Ikea furniture and you have to assemble it yourself, it's not simply a process of like, "Okay, open the manual, look at the first picture, find exactly those pieces, put them together."

Connie: We wish it was like that.

Karl: Right? It's not like that. One of the best strategies you can do is take everything and pull it all apart, lay it out on the ground, organizing into different kinds of pieces, align everything with the image in the book, and use this as a constant reference point to go back and forth. Right? And then you assemble it. All of this together, through epistemic actions, becomes part of the whole cognitive system.

Karl: In the extended mind view, you would say that the brain, the body, the manual, the pieces, the little bolts and screws, and even the floor, all of that that needs to be understood as a cognitive system. And the thing that, and not as a set of pieces, but as one thing, where the boundaries between those things have been dissolved, an action interaction brings it all together into a whole system.

Connie: I think that that can really help people who were learning designers think more broadly and perhaps to do a better job at design. Because talk a lot about how people have to practice. They can think in terms of the cognitive system that's needed to be able to practice their new skills, or to be able to apply their new knowledge. I think that it just broadens the way we can look at learning.

Karl: I have to follow up on that. I think two of the hardest things that people actually have here right now is, first of all, to recognize their default way of looking at the world. The default way like when you're designing an information and, "Well, if I create the information and I make this as clear and understandable as possible, I have done my job." You recognize that you have thought about this as perception in, cognition in the head, action out, that so suffuses our view of how we use information to understand, and how much we have discounted everything else.

Karl: And then the second hard thing is to build a vocabulary, a way of seeing these other pieces and talking about them in meaningful way so that you can recognize things, and then you can then design around those things and designed for that.

Connie: I'm so glad you brought that up, because it's so important that we have the words to describe things. Since we're focusing on interactions, can you talk a little bit about the large vocabulary of interactions that you have classified and organized into themes? Because that really helped me understand just the wide variety things that we do to figure it out.

Karl: First of all, we have this distinction between pragmatic and epistemic actions. And one of the questions that I began to have was, well, if we can make a distinction between two different types of actions, then we should be able to break down at least epistemic actions and begin to identify different kinds of epistemic actions. We should be able to put terms on them. We should be able to label them in some way so that we can say, "Ah, that's an example of this, but that, what the person is doing as an example of this other thing."

Karl: And so, when I set out to do was to build a taxonomy. At the moment that taxonomy has 15 different epistemic actions, organized into four different themes, each of these is not really about a physical movement. When we hear the word interaction, and we've talked about physical movement and what the body does, it's not about, oh, you moved your hand in to this way, or there is this particular widget on the screen. We're talking about interaction in a more generic concept here. And we're talking about it as something that is in theory, something that you could do in the head, just entirely through brain-based operations, but is beneficial for you to do in the world. Because that's the definition of an epistemic action.

Karl: Let me give you an example one of them. Think about cloning. Cloning is an example, you could call it copying, or duplicating, or replicating. And take the example of, somebody gives you their phone number and you say, "Well, I'm going to write that down." Now, you could remember it in your head. The information came to you, you heard it through your years, you perceived it, you store it your memory, done. But most of us don't do that. Most of us can't remember all of these things.

Karl: What we have done is we have written it down, and we put it in some other place. You're cloning that information into some other place. You could clone at information in a lot of different ways, you could write it down and pen, you could tap a bunch of keys. Imagine an AI system where any time that you are talking on the phone, or that you've got an automatic voice recorder, anytime in a conversation and says, oh, my number is blah, blah, blah, we would automatically go and clone that information, transform it and put it into your address book, and attach it to the person that you're speaking to.

Karl: So, there's many different ways in which it could be cloned. The specific technique that we have varies with our technology, varies with our designs, but we have a generic interaction here that runs across all of them, that it applies to how we would work with paper, how we would work with a laptop, how we could work with a tablet, or how we could work with any kind of technology which has yet to be invented or still widespread, like say virtual reality. So, that was kind of the idea, to look at and define different kinds of epistemic actions, give words to them, explain their benefits, why we might use them, but do it in a technology neutral way.

Connie: Interesting.

Karl: Cloning is one of the ones that I talk about. Another one is, let's say, annotating, or you're writing something on a PDF, you're making little notes, you're highlighting things. That's an example of something that we do all the time. Studies of how people, how, say, students, annotate documents have found that one of the most consistent features of those studies is, people who do annotations remember what they read better, they have better recall and they have better comprehension, even if they never go back and read the annotations. Just, actually, making the annotation has a cognitive benefit.

Connie: It makes so much sense. That's elaborating. That's tying it together with your previous knowledge.

Karl: Yes.

Connie: You mentioned that you thought filtering was important. Why is that?

Karl: Mostly because we don't have good tools for it. And we have so many things in the world. We talked about understanding as an everyday problem. Think about going to a restaurant and getting the menu. You're skimming through and maybe you're eating low carb, or maybe you have certain preferences that you don't like, or maybe you're a vegetarian or a vegan. There's a whole bunch of things on that menu that you're simply not going to be interested in. Or maybe you're just like, "I just don't feel like it today." All of those things are all visually there all the time.

Karl: You perceive all that information, have to, using your brain, filter out, Oh, nope. It's not these things here. It's not these things here. It's not these things there. And yet it's always perceptually accessible. So, filtering allows us to focus. It allows us to draw our attention to certain pieces of information. Imagine having a menu, it was all laminated, and they gave you a whiteboard marker. You could just like scroll everything out and you'll be creating a filter of all the stuff that

you're not interested in, and you would get down to the few dishes that you are interested in.

Connie: Great idea.

Karl: Because we know from decision-making theory, like Barry Schwartz and The Paradox of Choice, that when people have too many choices, they have a hard time making decisions, it creates cognitive load, it creates stress, and people often make worse decisions. But one of the simplest ways to improve that, is by filtering out the choices that you don't have, rather than having to remember. We have very few tools for filtering in the physical world.

Karl: In the digital world, we have lots of tools for filtering. In fact, I've come to believe that we have made a mistake in terms of the web, at least, and e-commerce and all of our websites, by focusing so much on search and not properly differentiating it from filter.

Connie: Interesting.

Karl: Most of the search process that we actually have is really not about searching so much as, "Okay. I'm kind of in the ballpark here." Search gets us in the ballpark. These are things which are probably relevant, right? You search for something on Amazon, you search for something on Google, you search for something on Netflix, right? I think filtering is probably going to be one of the killer-features of augmented reality glasses whenever they have. The ability to tune out the world, or at least those parts of the world that we don't need.

Karl: Filtering is only one part that's a particular use case. All of the other interactions are important for them taking what's left and stitching it together as part of the understanding process.

Connie: It makes sense. I was happy to see that you had chunking in there. That's such a big part of how we use instructional design to organize and sequence information and break it into small parts. We frequently use that mental action.

Karl: Chunking is an interesting one here. And bringing this notion of epistemic, with chunking, the original idea of chunking goes back to a paper by George Miller in 1958, called The Magical Number Seven, Plus or Minus Two. Widely cited. And many people in cognitive science will say if they were to point to a paper, a piece of research, which kicked off the cognitive revolution, that's the one.

Connie: Yeah. I can see that.

Karl:	I talk about chunking as an epistemic interaction. Not a chunk, but the act of chunking. And the act of chunking, of creating these chunks, of doing those kinds of groupings to aid memory, is an example of this kind of cognitive glue, of bringing together this idea of a chunk in the world as this external representation, to help facilitate, elaborate upon, punks we have in the brain. Computational theory of mind is not wrong, it's just grossly incomplete.
Karl:	And one of the ways that it's incomplete is we haven't accounted for the value of interaction for using information as this external resource, as part of our thinking process and extending what the brain can do. And the brain is super powerful in all kinds of ways, but it's also, very limited. That's example of where chunking, I think, pumps into this picture here, illustrates this difference between what's in the head and what's in the world and how we bring it together through an epistemic interaction.
Connie:	I think that one way for people to understand embodiment is: writing is thinking, sketching is also thinking. And the assistance that sketching out ideas gives you is transformational.
Karl:	Yeah. I originally started in engineering and engineering physics, and then wound up through a lot of stuff in computer science. In my experience of, say, being a computer programmer was that, well, the way I was taught was, well, first what you do is you create your flow charts, and you diagram everything out, and then writing software is simply going and implementing that in code all of this logical stuff that you have converted. And it never works that way. You pull up a text editor, you start bashing up some code, and then you just basically beat the whole thing into shape.
Karl:	That's how people write words. That's how you write an essay. That's how you write a book. I don't know about your book, but I didn't write this book by sitting there and going, okay, this is my idea. It's all in my head. I pull up my word processor and then I typed it from the first word all the way to the end. But that's... The interactive process was part of figuring out what the book was about how to articulate everything. And we do this all the time. But we're not only taught to think about it that way, and as people who designed interactive systems, as people who design learning systems, we don't always have a vocabulary for talking about it.
Karl:	Looking at what people are doing, it's like, "Oh yeah, that's this epistemic way of thinking. That's this embodied way in which they're using the resources out there." And so, that's what a lot of the book tries to do, is try to give people, not just some background, but also, a language, or vocabulary frameworks for

looking at these four major pillars that we described; associations, external representations, interactions, and then this last piece, coordination.

Connie: As a last question, how would you tie this all together? What are your recommendations for making it easier for people to figure things out?

Karl: Well, I think there's two ways I can answer the question. Other than you can buy the book. A lot of this has to do with overcoming, as we said, sort of some of our assumptions. Recognizing things that we have just kind of taken for granted, we look at and think about, we have assumed certain types of things about the mind and about the information we have in the world, how understanding happens. We need to be able to see with new eyes, we need to overthrow those assumptions.

Karl: The book has aim to give you a vocabulary for doing that. And I think there's two different aspects in which this can happen. One is, in your own life. Think about, we're trying to become aware, as you go through your day, how many times you are doing a small thing with your body, that seems kind of irrelevant and trivial, and it actually seemed pretty important.

Karl: We gave the example before of talking with your hands. We're still in the middle of the pandemic. People are doing a lot Zoom of same calls. How many people are talking with their hands on these Zoom calls? An why are they doing that? How many times are you making notes and writing things down? How many times are you annotating? Why are you doing that?

Karl: I remember when I got married, and we wound up getting married in my hometown in Canada, where my parents lived, because my grandparents were still alive but not traveling. My mom had a whole wall that she had created in the kitchen. She was doing a lot of the planning on the ground, with going to different places, and finding certain venues, et cetera, because we live like 12 hours away. She had this whole wall of sticky notes, and index cards, and a white board. And she had this great big physical space. That was her second brain. And the key to making that work was, first of all, putting it out in the world, but second of all was constantly referring to and interacting it with all these different sort of ways, to create meaning, to plan, to decide, to reason, to think through options and different considerations.

Karl: So, try to become aware in your own life about how you're not just keeping it all in your head. Look at the information you have, look at the tools you have. The other aspect, I think in terms of bringing it together, is, as you said, a lot of the people who listened to this podcast are involved in education in some way. You're a professor, you're a teacher, you're a trainer, you're an educator, trying to look and think about how your students are actually going to work through the

material that you provide them, what are the ways in which people use their physical space to try to create understanding? Educators have been told for years not the sage on the stage, but to guide on the side. One of the reasons for that is because people need to figure it out to actual learn.

Connie: But you know, a lot of the listeners are also instructional designers, learning experience designers, and often, it's for workplace training too. It's the same issue where they are asked to teach something, to create some experience, which is often e-learning, just one time, and that it's for compliance purposes, to just dump it all into their heads, and it doesn't matter. And no one wants to do that. No one wants to make experiences that are shallow. We want to help people learn, in a motivated way, things that are going to be meaningful to them. So, I think that this expands our options.

Karl: And to back to where we started the conversation, of why we wrote this book. We live in a world where there's so much more information, and it's becoming more complex, and we're asking you to do more things. And we live in a world where, as we pointed out, the science changing. We're getting new insights and some of our blinders are falling off about how the mind actually works in the role of the body, et cetera, and interaction.

Karl: But we also live in a world in which our devices are becoming more interactive, more partners with us through artificial intelligence, through sensors which can detect, and monitor, and respond to our mood, respond to our posture, respond to gestures that we are doing, those types of things. We are getting new technologies like augmented reality and virtual reality. And everything is becoming much, much more interactive. It's no longer a keyboard and mouse. We are taking information, not just information and cramming it into every nook and cranny of the world, but we're putting computation into every nook and cranny of the world as well. And sensors.

Karl: So, as these three strands come together, I think that the opportunities for creating much richer learning systems and understanding systems, is only going to become much more powerful. But, I think the key to it really, is to recognize that we can't get there just with the new technology, and just with more information, we also need to think about the conceptual tools that we have, the frameworks, the language, the concepts, the principles, the vocabulary use. The way that we think about how people go about creating and understanding with the information they have with and through technologies.

Karl: So, that's a large part of what this book tries to do, is to give people that kind of perspective, that language and those conceptual tools for thinking this through.

Connie: Okay. Thank you so much, Karl. That was a great way to wrap it up.

Karl: It's been very enjoyable. Thanks so much for inviting me.

Connie: I too think that embodied cognition should be an important part of how we understand thinking and learning. With this in mind, it can open up new opportunities for diverse types of learning and practice. And it should be personally helpful to become more aware of how we use cognitive aids to help us understand the complex tasks we deal with every day.

Connie: Again, you can find the show notes and a transcript at theelearningcoach.com/podcasts/64. I'd love to hear what you thought of this conversation in the comments. Take care, and I will talk to you next time.