GWEN GORZELSKY: Good morning everyone. Can you hear me? How about the folks in the back? Thank you TILT!

Welcome, thank you all coming to the 2015 TILT Summer Conference. We hope it's going to provide an engaging energizing way out of final grading. And into a relaxing productive summer. And we also hope that it will inspire you to pursue some connections between the learning research that you hear presented today and your own work in designing courses or curricula, instructional delivery or working with co-curricular programs.

We’re using the conference to announce a new TILT initiative that we’re calling the learning collaborator. The Learning Collaboratory is designed to make it possible from all CSU students to benefit from high quality educational experiences that are rooted in research on learning. And the Collaboratory is going to pursue three overarching goals in order to do that. First it will support research leading to new knowledge about learning. It will use the findings from that research to develop actionable strategies for courses and curriculum design for instructional delivery and for improving co-curricular programs. And it will share these strategies with faculties and staff members who design and implement academic and co-curriculum programs.

So to achieve those goals, the Collaboratory will use three strategies. It will promote collaboration between researchers and instructors or program directors who would like information on the academic impact of their courses or programs. And it will do that also by promoting collaboration between researchers who are studying those kinds of issues. Second, the Collaboratory will increase the profile of learning research at CSU. And finally it will disseminate research findings and implications in easy to digest formats that support ongoing improvement of educational programs, whether academic or co-curricular.

So we have structured the summer conference to support the initial launch of the Collaboratory. We’ll be providing you with more information as we head towards the fall. But we wanted to launch the effort today with the Summer Conference itself. So we’re beginning with a keynote address by Professor Phil Winne, an internationally recognized learning researcher who specializes in a specific area of metacognition namely self-regulated learning. And I’ll tell you a little bit more about Professor Winne in a minute but first just to sketch out the rest of the structure of the conference.

This afternoon we will spotlight some of the research that’s being done on learning right now at CSU and that’s making a national impact as well. We’ll do that through a series of lightning talks that will be given by CSU researchers who are studying learning and teaching. Tomorrow morning you will have a chance to engage more deeply with some of the ideas that you hear presented today. So we’re offering a series of workshops tomorrow that will be hosted or facilitated by Professor Winne and by each of the individual speakers or groups of speakers who will present
the lightning talks this afternoon. And what the workshop facilitators will do is give you an opportunity in a little more depth about the topic that they present in their lightning talk and also to start thinking about how you might apply that material in your own endeavors whether you are working to redesign a course, thinking about a whole curriculum, whether you are thinking about some aspect of your pedagogy or instructional delivery or whether you are thinking about how you might use this research and structure it into a co-curricular program.

So if you have not yet signed up for tomorrow morning’s workshops, please look at the TILT website and sign up for one of the workshops. You might of course think about the presentations you hear today and consider which of those feels like it might be directly relevant for you in the work that you are doing to move toward your fall courses or the next iteration for one of your programs. As I said, please think about which of the workshops would be the best fit for you and do sign up for that.

So now I will take a minute and introduce Professor Winne. We are very delighted that he’s here with us. He researches, teaches and serves as an Associate Dean at Simon Fraser University in British Columbia. His work is an outstanding example of research on learning and its potential to improve both teaching and learning. In addition to winning over $12 million in research grants and publishing roughly 150 books, chapters and articles, Professor Winne has been named a research fellow of a number of prestigious organizations – the American Education Research Association, the American Psychological Association, the Association for Psychological Science and the Canadian Psychological Association. In 2007, his work honored with the Robbie Case Memorial Award for outstanding contributions to educational psychology in Canada. And as I mentioned in addition to managing this internationally acclaimed research program, Professor Winne serves as Associate Dean of Graduate Studies and Research at Simon Fraser.

His research, as I mentioned, focuses on metacognition and self-regulated learning. He’s looking particularly at studying students’ habits of studying and using software tools to research how students can learn to study more effectively. So he investigates how students monitor the quality of their study strategies and focuses on what they learn from that activity of monitoring and whether or how they adapt their initial strategies to make them more effective and to improve what they’re doing to learn more effectively. He’s now working with colleagues to develop a state of the art software called nStudy and study both help students to study more effectively and provides data to help researchers to better understand the role of self-regulation and related strategy since student learning. It’s used to build learning kits which are made up of structured multimedia content that provide cognitive tool that help learners to study more effectively and learn how to do that themselves. In addition to helping students, as I mentioned, nStudy also collects data on how students use their initial basic study to create and adapt new learning strategies as well as data on how those new adapted strategies impact student learning and their academic success.

Through their study Professor Winne and his colleagues are learning how to better promote collaborative learning, information visualization and self-regulated learning. So please help me welcome Professor Winne today.
PROFESSOR PHIL WINNE: Thank you. Thank you very much. Gwen thank you very much for that very generous introduction. I’m sorry to report that was really my twin brother he was describing and I’m the black sheep of the family so your expectation should be lowered just a little.

I’m very happy to be here. I had a wonderful evening last night learning about some of the things going on here at Colorado State and making a few proposals of my own which I hope may resonate and perhaps spur some thoughts about you can be doing the work that you want to do. What I’d like to do today is describe a route that we might travel in thinking about how we can support learning from multiple perspectives, from the learner’s perspective, the instructor’s perspective, the institutional perspective. And one that I won’t say much about but that I actually think is very critical, the publisher’s perspective.

So I want to describe this as going en route to a destination. There are several destinations to which people might arrive in thinking about these types of topics. Mine is certainly not the only one. But I hope it sparks some thought on your part. So, our agenda today is going to consist of a couple of parts. And I might say something about my presentation style. Unlike many people who put up slides and effectively read them, I’m going to ask you to read. This is planful. It engages you a little bit more than if you’re just listening to me. It helps me control my time because PowerPoint is going to dictate the rate at which I’m going to be going on. I hope that you will find this engaging and I’d be interested to hear your reactions to this style at the end of the talk.

So our first topic is I’m going to take up in a little bit of wide spectrum view about what robust learning might be considered to be. I’d also like to talk about the question of what learning science has to offer to thinking about a notion of robust learning. Self-regulated learning -- that’s my thing but I’ll promise not to spend too much time on it. I want to talk about tools for enriching learning and self-regulated learning, as Gwen was mentioning the software that we’ve been developing, apparently forever and it’s never ending. I’ll show you a little bit of that today. I want specifically about something. I’m not sure if I actually introduced this to the world of learning science but the idea of putting tracing paper over people’s minds so you can get a window into the ways in which they are thinking. Learning analytics which is a burgeoning field, one that I’m highly recommending in the institutional scene to take up with great ardor. And at the end I want to talk a little bit about a community of practice and an ecology of experimentation. And, finally, over to you for a discussion.

I understand this is scheduled for 2 hours and I can’t imagine this going for 2 hours on my part. So let’s have some opportunities for discussion and I hope you will find some particulars in here that you might like to remark about at the end. So let’s begin. Topic of the conference is robust learning. What is it?

So this description comes from the Learned Lab which is a collaboration between Carnegie Mellon University and the Pittsburgh Science of Learning Center. They have a view that is deeply
rooted in notions of intelligent tutoring system and you might perceive there’s a rather strong cognitive overlay in the ways in which these people are talking about robust learning. In the context of those tutoring systems that teach specifically physics and algebra. Resilience sometimes known as grit is a very critical element, I think, in robust learning because learners, whatever cognitive tools they may bring and whatever supports we may provide for them, themselves need to stick with it. And this is, and I have highlighted this notion of a process, it’s not an individual trait in my view. It’s a way of engaging with the world with instruction in a particular way that accommodates or at least holds as goal these elements that are listed. I’m not going to talk much about exercising self-control or nurturing a positive self-concept although I consider them to be important elements of this view of resilience. We’ll see a little bit of the first four of these bullets throughout the talk. So this is another view I think that is critical that augments a sense of resilience. Motivation is something that is evident throughout human behavior. In fact, it’s sometimes argued that we can’t behave other than reflexively without motivation and this particular collection of facets of motivation is one that draws from a couple of bits of the literature, the efficacy and outcome expectation particularly from Bandura’s social learning theory, incentives from older theories of motivation, attributions particularly from Bernie Weiner’s attribution theory of motivation and I like to think of these as coming together somewhat indicated by that darker line here as a kind of addition, although it’s a much more complicated calculation than that into a notion of utility and I want to borrow here the economist’s sense of utility, particularly one of marginal utility, that is what’s the added benefit something different that I’m currently doing.

When I teach undergraduate courses, I aggregate these into a nice little mnemonic the vowels that gives color to our speech or if you’re in a choir you’ll know very much about how you are not supposed to be doing eeem but aaah. So, remember the a e i o u model. It’ll come up a little bit later. So here we have another lens piece for looking at the motivational feature of what’s going on in robust learning and the elements in green are the lingo that is used in the motivational psychology, particularly to describe this notion about effort for control and the emphasis really here is on control. The person, the learner, is in control. No matter what we might think about the ways in which we are going to encourage learners to do this or that about the things that are going to inevitably happen when we present to them some kind of instructional cue, they make a decision about how they want to engage with this. And the facets of that decision are incorporated not only in the a e i o u model just mentioned attributions, efficacy expectations and so on, but in these notions about inhibiting something, not doing something that’s just absolutely automatic but retreating to think a little bit about is this the right way I want to engage or attention control keeping a little bit of vigilance going in. I was just reading something on the shuttle here from the airport about how critical that’s been demonstrated to be in genuinely educational applications for infants to about age 6 year old children. And activation control which is this notion about thinking of now that I realize I’m supposed to do something what is it that I’m going to be doing. What am I going to activate? And that’s definitely a choice laden event for the learner, if the learner has options. And I’ll talk a little bit about that later as well.

So before we launch into this notion about experimental findings, I want to leave you with this view that while I’m pretty much a cognitive psychologist, I do not want in any way denigrate or
undermine the criticality of motivational features in the sense of what I consider to be robust learning. And what I want to move to now is a discussion that I think several of you may resonate with. To put it bluntly, it’s a critique of randomized controlled trials in their utility. Most of what’s going to appear here is going to be published in an article in Teacher’s College Record, if the website is to be believed, in Issue 9 this year. So, I’m going to be arguing that people need information or data as these kinds of phrases describe it to be, not only to theorize about what might work or what’s been going on, but also to counteract this notion you see in Jim Barksdale’s quote here about, you know, if we don’t have any data, let’s just do what I think is best. And what I’d like to do is trouble you in thinking about the role data may play for you as an instructor or if you’re the institutional level for guiding activities at that level and for all of us who are learners, the role that they play for us. This often happens to me. People knock at my door, particularly for my courses and they say I’m having trouble figuring out what these readings mean or what your lectures are describing and I used to be like Dr. Arsquare.

That’s for you those of you are not statisticians, this is a measure of the percentage of variance accounted for an intervention or a factor. In some measure of achievement or motivation. And I’ve now come to believe that I’m on incredibly soft ground if I say something like “you know the research shows” or “we know.” And I want to describe to you why I’ve transitioned from a kind of classical experimental psychologist into a rather retreating one.

So, those of you that run experiments of the classical variety know that you try to exercise all of these kinds of controls, carefully guarantee that your treatment is implemented as you intend, that your participants in your study realize that you what you manipulated is an independent variable actually registered with them and so forth and so on. And in the real world, it’s a rather different story. So, we face an incredible gap to span in trying to make generalizations from the character of the studies that we do in our lab and even when we do field studies under relatively controlled conditions to when we set loose some notion of an intervention. And this shows some of the ways in which that happens and this is one of the common complaints about why instructional research has difficulty materializing in the field, in real life, in the way that it ends up being observed in experiments. There is much more.

So this article appeared, as you can tell, very recently in this publication Perspectives on Psychological Science, published by the Association for Psychological Science and it was sort of the nail in the coffin for me. I’d been trying to work this out myself for a couple of years and wasn’t able to do it and was very happy to see these people publish this. This is a not inconsequential effect size. It would take the average person, which doesn’t actually exist, to the 74th percentile if they started out at the average, which would be the 50th percentile for whatever intervention we might be talking about. Here we’re assuming a reliability, a psychometric concept for the outcome measure that’s typical for many experiments, quite a bit higher than what one would expect to be observed in any real life setting and under those circumstances I’d like to point out the range in which you might expect. The next experiment. Big important qualifier – using exactly the same sample with no carryover effects. So if you wanted to predict what the next group of these same people would be doing and where their average would fall, it would be somewhere in this kind of an interval.
The challenge, of course, is that we never perfectly replicate an intervention whenever we apply it to a new group of people. And when you use a new group of people, this interval widens even further because additional variance is introduced that that new group brings that aren’t perfect replicates of the factors brought by the group that was involved in your study. So when Dr.Arsquare says I just read a study this should give Dr. Arsquare a great deal of pause in thinking about how firmly or energetically to recommend the finding of that study. And by the way this same kind of issue applies to meta-analyses as it does to individual study. All we are interested in here is an effect size. It doesn’t matter how big the sample and how diverse it is from which that effect size comes. So I’m repeating a little bit here from the preceding slide. And what I want to drive home in this slide is the view that this picture you can picture the regression line, what you would predict following through all of these dots like so but pick your favorite moderator variable – sex, ethnicity, SES, high school quintile, whatever it happens to be. You’re going to get different groups and each one of those is going to have a different regression line. Each of those subgroups is going to have the same challenge I mentioned earlier about a study onto itself. And right here is yet one more important factor.

Those of you that maybe have studied multiple regression and know about the Johnson name and interval – I’m just trying to impress you at the moment – but the idea is that let’s take this, whatever color this is, salmon, something? Your prediction is reasonably accurate. The usual confidence interval is right there in the middle of that regression line and the actual confidence interval is not as many statistics books show it two straight lines that bound that regression line. They’re actually hyperbolas that go like this. And as you move away from that mean, the predictive accuracy gets terrible.

So unless I am a perfect representation of the statistical average at which point you’re going to have usual confidence interval as you see here, you’re going to have an even greater adjustment to try to make some prediction about what is going to befall me or benefit me when I participate in the treatment. And I say befall because we also need to remember there is the downside on the mean as well as the upside.

We often lose sight of this when we’re thinking about oh I read a study and it found, so you should do this. So each of these factors further makes it challenging to use and experiment or the findings of a meta-analysis to suggest any particular individuals what she or he might do to try to learn faster, better, with greater retention, more transfer, increased creativity, better satisfaction, pick whatever collection of outcomes you would like. In fact I think it’s just amazing that anything really works when we do this research.

So, there’s a bit of salvation here for those of you at the institutional level who are focused not only on the individual but on groups. The research literature is not completely muddled and useless when you are talking about groups. That’s what it was designed to examine but when you want to step down to the level of the individual or even subgroups, it becomes rather mushy. And what I hope to convince you of slightly, this morning, is that there is a way out. There is a way we can begin to address this problem en route toward helping learners become more robust.

WOMAN: How big is a group?
PROFESSOR PHIL WINNE: How big is a group?

WOMAN: As opposed to a subgroup.

PROFESSOR PHIL WINNE: That of course depends on the size of the initial experimental group. Typically, so we pick up a Journal of Educational Psychology you’ll see groups ranging in size from about 30 per group up to some of the very large scale pizza like studies international comparison studies where they have thousands or even tens of thousands. It doesn’t really matter. The same challenge about generalizing from a group to an individual qualifies. The only thing that additional size of a group gather buys you is that the confidence interval for that mean is shrunken as group size gets proportional to the square root of that group size. But you still run up against each one of these issues when you try to generalize from the group to an individual. And group size doesn’t – if I can make this go back one – group size doesn’t do anything to help you with this, with this, with this, with this.

Okay.

So if you hadn’t read this before. This fellow, Nozick, was at Harvard who this very lovely introductory philosophy textbook and in my efforts to try to acquire a liberal education I read a few pages of it, this being one of them, and given the context in which I’m portraying our learning science, I think this is a very apt quote. We need to be respectful would be one way of putting it, sensitive is another way of putting it, to using the traditional approaches we have to viewing research as signposts for how we might be working in our respective positions as learners, as instructors, for people in TILT, for people at the institutional level. And again I’ll offer some opportunity to weasel around this little bit of a problem.

Let’s talk about one of my favorite topics of regulated learning. What is it? It’s a program of personal research. We have this view of self-regulated learning. First of all, self-regulated learners are better learners. I want to disabuse you of that mistake. Every learner is self-regulating. They’re just sometimes not regulating in the way you might like them to or in a way that’s optimal. One of the best examples of this is the self-handicapping learner who says, “You know – efficacy expectation – I don’t think I’m going to do very well on that test so I’m going to play it off and watch some of those Stanley Cup playoffs.” Why would a person make that decision?

Well, they might not be as thoughtful and articulate about it as this but here’s a possible explanation. I predict them going to do pretty poorly, outcome expectation. I don’t think I have the ability, anyway, efficacy expectation. The incentive for me is not really all that high because I’ve been this a long time and I’m used to being at the lower end of the grade distributions in my classes, so what difference does that matter? Ah. And what attribution can I make? Well, now I need to make up an excuse and here’s the excuse. If I do not study and I watch the hockey game instead and I should happen to do well, what attribution can I make? Well, maybe I have a little more ability than I thought. Or maybe I was just kind of lucky. Either of those, the outcome is good. No big issue. If I don’t do very well, you know, if I had studied instead of watching the game, I’m sure I would have gotten at least a B minus. But I did watch the game and consequently, that explains why I get my usual D or C minus. There’s the self-handicapping. That’s a self-regulated
activity that’s just that the choice of the option to pursue – studying versus watching the game – turns out to not be particularly beneficial. So if you take away, well, I hope you’ll away lots from this talk but one of the things would be self-regulated learning is not always beneficial. It depends on what is regulated and what the choices are about what’s regulated.

So it is rather complicated. Starts out according to the model that Allyson Hadwin and I published a while back that learners take some stock of what’s going on about the task. What are the features in the task environment? What resources are available and so on? What about me as an individual personal features. These are just illustrative kinds of questions the learner might ask. Once I get the catalogue of what the case is at the moment, I would set some goals. Am I interested, for instance, in this goal orientation, very popular in the literature these days? Am I a master in it? Do I want to understand this stuff or do I just want to get a good grade? Performance oriented. What are the consequences? Here’s that outcome expectation I was mentioning earlier. Effort required. That’s a big concern for students. They like, all of us, like to minimize the effort involved. Given that and a couple of other considerations, how do I go about doing what I need to do to reach the goals that I’m setting? Can I transfer prior experience? What learning skills do I have and which of those will be useful? Then I engage. OK. What do I actually know about this? What's the information that's given? I apply operations. I check how I'm doing. I engage in monitoring meta-cognitive because I'm not asking only am I able to factor these algebraic expressions and able to address this oxidation reduction problem. Can I whatever it happens to be? But how's my effort? Am I having to put out too much work here? Is it taking too long? Is it going well? Do I think I need to review some material that I didn't recall in the first place? All of those are not about the answer and the specific elements of the process I'm using to get the answer. They’re about many of these other features here. Maybe I should adjust the goal a little bit. Maybe I should etc. Then I take some action that's meta-cognitive control. I might decide to review something. I am somebody and ask them if they figured out how number two actually works. I might decide, okay, let's just set this aside entirely. I'll abandon this until I can get some help from my TA or the professor or the lab instructor, whoever it might be. All kinds of options are available for regulation and round and round it goes. This, by the way, shameless plug for those of you that want to engage in the workshop with me tomorrow. We're going to do this. I describe self-regulating learners as engaged in a program of very personal research. So if they're personal researchers, they need to be scientists. They need to engage in scientific thinking.

This is a nice review article that describes across the spectrum of mostly early grades and middle school levels what scientific thinking looks like in the context of the curriculum and the cognitive psychology that students are engaged in. And notice theories. The old saw there's nothing so practical as a good theory. Why? A theory points you in directions of things to consider it. You don't need to worry about that and this is going to be really influential. It suggest things you should look for along the process because nothing happens in an instant. There is usually a series of steps to go along so you have some explanation for what's happening. If you're a cognitive psychologist and problem solving you'd be talking about sub-goals for example. And scientists don't just do this study and say that was nice, let's do the next thing. They're thinking, well, what, why did that work that way? Why did it not come out exactly as I predicted? What was the issue
that interfered slightly with this part of what was supposed to be happening. How can I tweak my instrumentation. What about etc. Thinking about the process of experimenting as well as about the topic that's trying to be learned is what a learning scientist, also known as a self-regulated learner needs to be doing. Oops. So, this is a very important list. The reason it's very important is not because it's recapitulating what most people learn about when they study the scientific method. It's because and here I am going to refer back to the research and rely on what's described about groups. This is what people have trouble with. Everyone one of these factors has been demonstrated in some degree to be a challenge, a huge challenge, to people learning to develop a view about the world as a scientifically describable activity. So if we're going to promote robust learning, we need to help learners develop these kinds of perceptions, values and skills. To put it more bluntly. Every learner needs to become a scientist. There's a benefit to this because when one engages in thinking like a scientist while working in a domain ecology or whatever the case may be, there's payback. Thinking like a scientist at the group level, anyway, tends to elevate knowledge in the domain of ecology. It's a symbiotic relationship. So there is not only cost in terms of time and focusing on the notion of being a scientist.

There's benefit in terms of promoting the learning of whatever it is that's being studied. A historiographer would talk about this in different language but it's pretty much the same process. So, I couldn't get away without quoting myself in the whole talk, right? So, scientists, historiographers, anthropologists, all rely on data. They need data, also known as feedback. And what's important for us to give some thought to is the data needs to be not only about the topic that's being studied but about the elements of being a scientist also.

So, in terms of learning, process feedback. What did I do? Let me take an aside here. A long time ago, a student of mine, Diane Jamieson-Noel and I did a little study. We had a piece of software in which learners could study some material and there was a button that they could click and the button said 'Learning Objectives' and when they clicked that button the requirements popped up and it had a list of learning objectives, which we thought would help people learn better because it would set some goals for them back on that slide for self-regulated learning. And then at the end of the experiment we administered a little questionnaire about features of the learning environment and one of the questions was "How helpful were the learning objectives?"

And the interesting thing that happened with, I believe at least two of the participants of our study, who said they were helpful. Unfortunately, they never clicked the button to see the learning objectives. I went wow! Here are people who are badly mis-remembering what they did. And if they're in a position like that how are they going to very helpfully think about what should I be changing in the way I'm studying if I'm not doing so well or what should I be repeating if it working well. This information about the ways in which you are engaging with the learning activity is a feature of feedback that is critical for self-regulated learning. So there are a couple of things that we need to do on the outside of the learner as well. One of them: complex tasks. If the task is too simple, there's not a great opportunity to be engaged in productive scientific experimentation. It needs to offer genuine options. There needs to be encouragements to experiments. There are all kinds of disincentives for this. It could go wrong. It could take more time. It could lower my perceptions of my self-concept. It could give others the impression that I'm a poor learner, or uninterested or you know the list. It's long and sad. We need to find ways
to help people to encourage to experiment. That means we need to give them this permission which is extraordinarily difficult. If you are teaching in an area where some external agency says if you want to be civil engineer there are these 4,811 things you need to know. And you have only a short time to get through all those 4,811 things. Nonetheless, we need to try to figure out how we can help people realize that this is not working well. Error may be too harsh a word. Unexpected or not desirable outcome, might be a better word to use. But we need to create a context in which it's okay to make a mistake. There's a cartoon that comes to mind that says: "if we learn so much from our errors, shouldn't we be making more of them?" That's the kind of attitude I'm talking about. And we need to provide opportunities for learners and instructors and so on up the line of decision making at institutions about these kinds of features. Everyone needs information about this but especially the self-regulated learner. And this notion about scientific community, which I'll return to at the very end, there's now growing evidence, again, at the group level that suggests that social interaction is a critical component in productive learning. You can get by without it. But it's a little bit more fun sometimes and a little bit more beneficial with it.

Micki Chi is particularly making this point in her ICAP framework if that is familiar to you. The 'I' being interaction and the most prominent of these factors. But this notion of community, as I say, will come up a little bit later. So. What I've done so far is lay some groundwork for the following general position. Learning science has taught us a lot about how groups work. And it's not at all inconceivable that some individuals in those groups are working exactly as learning science describes. For the rest, what we find from learning science, I think, ought to be taken as useful but fragile hypotheses, particularly fragile for a learner. Let's not throw out the baby with the bathwater. Let's take advantage of what learning science has provided for us. But like good scientists, treat it as a hypothesis to be demonstrated or modified rather than a truth. Let's recognize that in this process of treating things that way, from learning science, not only we as instructors or vice presidents or associate deans but the learners themselves need to be scientists and we need to provide supports for them as well as a context in which it's okay to do that science. And like scientists, they will need to follow a particular set of skills.

There's some latitude in the ways those are taught and exactly how they are framed for the domain and the age and so on of the learner. But there is a pretty good grasp that's grown up through centuries of work in science of varying kinds of how that plays out. We need to help learners develop those scientific skills, think scientifically and we need to provide them with the data to engage in that scientific process so they self-regulate. So what I want to turn to now is a brief description of this software that we've been developing called the nStudy. There's nothing magical about that. I just had to put a letter in front of study so 'n' was for new. Not terribly creative. Every one of you, I suspect, has had other hopefully a positive engagement with but some engagement with learning management or contact management system. I won't ask for your opinions about yours. I understand you are either migrating to or now using Canvas which is what we're using at Simon Fraser University as well. And you know it collects various kinds of data. When students log in and what they download and other sorts of things. And that's some useful information that we can use to provide some supports for learners. But I think that there's a lot that goes on in-between the bookends of what learning management systems record and
the achievement data that we're interested in promoting and the motivational and satisfaction and other factors that we'd like to elevate. And nStudy is designed to get into the pages of that book.

By the way, that is an amazing sculpture if you couldn't see it.

This is a quick overview about some of the software's key properties. And it has a couple, I think, advantages. I designed it initially thinking I want to have instrumentation for my laboratory research and as I talked about it with people they said, "Yeah I'd like to use that too. How about if this..." So in the way that these kinds of things typically go, it exploded into a overwhelmingly large and never ending project. But to point out a couple of things. One is an advantage that the curriculum is anything you can put on the web in HTML or PDF which pretty much covers everything since you can convert ePub to PDF and so on. And it was designed that way because what do learners do if they can't figure out to accomplish whatever their assignment is? Got it. Right. And also because I wanted to be able to research with it. We can configure a variety of things and I'll point out just a few of those as we go through some screenshots I'm going to show here. So. Here's an HTML page. The learner has made a selection of this screen text. In the old version they had to press a key and click the mouse to get this menu to come up.

Just so you can see what that menu looks like, these are the features that Firefox includes in its popup menu when you press the right key and click the mouse. We've added a few down here. These are completely configurable in the nStudy environment so if you want to do a specific kind of experiment or afford a particular kind of instructional environment, you can. And what the learner is selecting here as you can see the cursor is that they are quoting this bit of information and I'll explain why it's called a quote in just a second.

Over on that right hand side here is a we're not sure what to call this -- table of contents, activity log etc. Here's a bookmark that the learner has actually the software made this for the learner because the learner operated on this page and so we've constructed a bookmark for it. Here's a quote which was some text that the learner selected and we call it a quote because it gets copied verbatim into the learner's work space. Here's a term for organic and here's the definition of it. The instructor or researcher can supply terms like this or you can let the learners create their own or you can have a mixture of those feature and like email you can attach this as a document, an essay or a project the learner is working on. So if for some reason you'd like to have a connection between this term and a larger work that you're constructing, you can do that and here's another quote.

So there were a variety of things that get recorded over here in a record just like the history of your browser or the things that you've done on this webpage. That's a study space. Here's chat. The layout is a little bit similar to many chats. Here's the list of participants. Here's the title of this chat. Here's the record of all the things being contributed to the chat. We have a little bit different take on how you enter information into this. The literature in computer supported collaborative learning as well as lots of other literature demonstrates that when you put people in groups, they don't know what to do. We're trying to give them a little bit of a boost. They can pick a role: summarizer, critic, task manager, whatever set you happen to like. Once you've picked a role,
you get some suggested prompts. You know, now that I am the summarizer, what does that mean? So what's this part about? What's the main point? Can you put that in your own words?

Those of you that might have some familiarity with learning science literature will know that things like paraphrasing like this at the group level tend to have some benefit because translating from one set of symbols to another set of symbols to another set of symbols even if it's just words to words or from one representation like an algebraic expression to a graph, parabola or hyperbola, those kinds of things tend to promote retention. So what happens here is that you can just type whatever you want in here if that's what you choose. Or you can click one of these and it gets copied for you and then you can type whatever you want. So you see here some ellipses that invite the learner specifically to add something there, namely what the topic is that should be given a summary. Here's a document. This is the essay or lab report or business plan or whatever other kind of production. So here's the. It's an HTML but it looks a bit like a word processor. There's your usual toolbar where you can format things as you are accustomed to doing.

So here's the student working on this project -- can life exist on Mars? Here they have dragged this quote over into the document that they're drafting. Here they're saying something about amino acids and here they're adding something I'm just going to show you in a minute. The notion of this design is one of things that the literature about writing demonstrates is that first of all, people rarely engage in drafts and those who do, particularly if they can get some feedback on those drafts, tend to produce more coherent, more complete, better presented compositions. What we're trying to encourage by this, well, let me just go back. Wrong button. Is by this drag or drop operator or copy and paste, if you wish, is to begin thinking when I'm studying my primary sources, I'm kind of pre-drafting what I'm going to be using. So I'm building up a mindset that says as I'm engaging with the primary sources for my project, I need to be thinking about what I'm producing at the end. The goal for self-regulated learning and for the domain. And it creates an opportunity for us to give some process feedback of the sort are you using the material in your primary resources or are you not. What was the purpose for quoting the things in the primary documents -- because it helped you understand better but then you don't end up using in your project? That could be okay depending on what the envelope is for your project. Or are you picking the right things out of those primary sources for the project that you are working toward. We are set up to provide that kind of feedback to the learner and engaging the learner in thinking about as a scientist how's it working for me when I make my selections. To speak more like a cognitive psychologist. What standards do I have when I meta-cognitively monitor my primary documents to select this as a quote instead of that as a quote? And providing data about the thread that runs through the studying activities in the first instance which if the learner is well planned, may have taken the place weeks or even months before getting to this project.

Thinking in this way creates an opportunity to begin crafting. I like to think about nudging learners towards drafts are a good thing. And I can be thinking about the draft I'm going to construct all the way at the very beginning of the process when I'm looking at a primary document on the Internet. Okay. Now here I didn't show this earlier in the study space. One of the features of our notes is that they are web forms. You've filled these out before when you've reserved a hotel
room. What kind of room do you want? And do you have special needs and so forth. We can design these in any way we like.

So here is web form that's inviting a learner to say what's this note about. Here's a tag. So this might be the learner's personal lingo for 'I need to do a little more research about this and I'm going to tag this so I can find all the things that I thought I needed to do a little more research about and collect them together later and go search for those things.' Here's a schema, as a cognitive psychologist would call. An outline for the things to think about when you want to explain something. What's the cause? Well the learner hasn't figured out what that is, yet. The effect that was reported in the text was here. Here's a context that matters. And this is supposed to be the reason this text will disappear as soon you start entering some of your own text in that but you can give the learner a little bit of scaffolding to say "so what are you supposed to be putting in here"? Those of you that might have been engaged with notions about learners writing arguments one of the favorite schema's for that is Toulmin's Structure which has a piece of it, the warrant, which gives the reason why a bit of evidence is appropriate to support or deny a claim that you're making. Walk around the hallways and say okay I'm arguing what's a warrant. Something you arrest people with. So you could tell people in this thing why is this evidence relevant to the claim, teaching them not only a little bit of the language they might use to think about how you craft a complete argument and providing a shorthand for that in the lingo of what a warrant is and eventually they'll get so they don't even have to read that text. They'll learn that terminology as well as the structure of what in this case an explain note consists of. And that note also can be borrowed from before right here.

Here's a search opportunity. So again here is a collection of all the things I've been constructing. Here's a list of them here. Put a string of up here and you can retrieve everything that has the word meteor in it. You can restrict that, I've forgotten what I have here for the blow up. Apparently nothing. [Laughs] Or maybe I pressed the wrong button. Yes, I did. Okay. So you can restrict that if you say, again speaking like a cognitive psychologist, my episodic memory, the memory I have for this particular studying session in which I was engaged, I think it was in a bookmark or a...it wasn't in a note, it was somewhere else. So I'm picking where those are. Here are the number of those that you have. As soon as you start searching for something, these will reduce because not everything will have meteor in it or whatever you're searching for. What this also provides some opportunity to do is if you put #findout up in the search term you'll of course retrieve everything that has that hashtag tag -- that's kind of redundant, in there. [Laughs] And what's the affordance here, what's the opportunity? A learner gets the chance to think about into what categories should I be organizing the information that I'm viewing, quoting, constructing in my own notes and so forth. Are there some notes to myself that I want to make about I need to explore this a little bit further for my project. The place where I'm currently working doesn't have enough information. Or I don't understand quite enough. I need to get some supporting documentation to help me.

Again, this is nudging a learner toward thinking about ways in which they can take advantage of what the electronic media provides, engage with themselves about they can go about learning in a more productive way. And they may if they have data, which we can supply, I'll describe in a second, discover you know when I'm in Twitter, I'm using gazillions of hashtags but when I'm
studying only three are important to me. That's scientific thinking based on a series of engagements with this data over time on a hypothesis that says tags are useful but not all those tags I first thought of. That's what we want to try to encourage in the context of the software. And again, here's another note template showing we've got all the gooey graphical user interface widgets, sliders and check boxes and radio buttons and date fields and text fields etc. And, again, here's what I was describing earlier about warrant. Here you're giving some nice scaffolding for a person who doesn't know what argumentation is or has as a structure. You need to have these four things.

A lot of people, what again the group based research shows that most people have lots of claim. They don't always provide evidence for every claim they make. And they almost never include warrants or limits. Stronger, more compelling and more accurate argumentation has all of those elements. So what do we do we with all of this? Traces. What's a trace? Let's do it the simple way. Does anyone here never underline or highlight, put your hand up. I thought so. First of all, again on the group basis, you're doing a good thing. We just did a meta-analysis on all of the studies about underlining and highlighting. And the effect size is about 0.45. So, keep doing it. What is a trace? What do I learn about you when you underline or highlight something in particular? I learn quite a lot. First of all, I learn that you're paying attention to particular kinds of things. Otherwise you'd be like that typical undergraduate who has the whole page yellow. Right? You're making discriminations.

I might be able to discern, by looking at the, in nStudy's terminology, "the quotes," the things that you highlight, what the meta-cognitive standards are for your monitoring. You might be highlighting definitions. Or explanations. Or the pro and con for an argument. You might tell me more explicitly what your standards are for meta-cognitively monitoring the text if you apply that age or if you made a note of particular note form called the definition, the thing that you're defining. What the definition is. And then, we have another field called "see also" which gives you the opportunity to connect things to other things. By engaging in those activities, you're revealing to me what's going on up here without me having to interrupt you and I think allow protocol that says keep talking while you're working.

Of course learners are working and their cognitive load, all their reserves, are engaged in the thing that they're doing and they often forget or don't have the cognitive resource to tell you what they're doing. This is all rather natural. Just highlight. Bingo. I know you're paying attention to particular kinds of things. I may know what particular things you are paying attention to. You might even tell me explicitly what those are. Use a hashtag. So and so. Find out. That's a trace. It shows me, in a behavioral manifestation, in the database of your learning sessions, what's going on in your mind. Of course it's incomplete. But it's a very valuable step, at least to be able to play back the record of what you do. I told the developers of nStudy I want to have the data in the database for each learner. So if I had a playback machine it could read that data and I could watch on the screen absolutely everything the learner did. And that's what we have with two exceptions. Just moving their cursor around the screen, we don't record that. And for some reason that I don't understand that's technological we can't know where the elevator is the scroll bar is positioned. But we can, for example, but we haven't implemented it yet, take a snapshot
once in a while that'll say what's the first word or symbol and the last word or symbol on the page and since we record all of this in the database, we know we can get some sense about where you are in the material. Anyway, traces are a mechanism for a person to interpret what's going on cognitively, including the learner, her or himself. So here are some examples. This is what we want to provide for learners so that when they're figuring this out as a learning scientist, they're working from fact, rather than human memory which is fallible, erroneous, well that's the same thing as fallible. So now I'm going to go on a vocabulary hunt for words like fallible and erroneous. Reconstructive. We often. Human memory often makes up things that logically fill the gaps of what we can’t remember. We have all kinds of foibles about memory. Let's try to trace as much as we can about the learning operations. Learning analytics does this. So this comes from the Society for Learning Analytic Research SOLAR. You can find it on the web at that URL. All of these features are critical and there's something very important to realize. Any instrumentation places some perspective on that data. I'm going to go into that a little bit more. But what we want to do with this data is understand, optimize and improve.

Oh.

So this line about understanding, as we go back to thinking about this, to understand something, we collect data in certain forms. And that forms means that what is typically labeled raw data is really an oxymoron. We have particular understandings about the data before the data come into our hands or into our database. And consequently -- this is really unavoidable and it is illustrated in a very lovely way through the history of science about ways in which, for example, energy was measured. Temperature. Or in more socially constructed notions of, for instance, self-concept and its eventual differentiation from self-esteem. All of these bits and pieces influence what we interpret. Let me give you a very, I think, tremendously clever example but we'll see what you think about it. I want to ask you all to raise your hand. Yeah. Raise your hand. Everybody's got their hands up? Good. Do you like ice-cream? Seems everybody does. Do you like coffee ice-cream? Some put their hands down. Would you like to have coffee ice-cream with pancakes and sausages for breakfast?

[Laughter]

I'm with you guys. But here's a business about the way in which we think about data before we actually gather it. Here's my instrument. It was the question, "Do you like ice cream?" A kind of self-report item that you'd see, you know. When I study, I generally pay particular attention to the definitions. Well, just like the ice-cream example, you might change your view about this if you performed a complete survey of all the memories you could recollect about when you're studying. And just like the ice cream example, as a person who, anybody here in decision sciences? So in the decision making literature, the context for an item makes a big difference. So in political polls, pollster will order the question in a particular way -- this is called the framing effect. So when you get to the critical question, you're in a mindset to answer it positively or negatively. One other reason to distrust polls. The same thing happened with ice cream. If I'd thought to say to you now think about all of the flavors of ice cream that you've ever tasted and the contexts in which you would be eating the ice cream, now how would you answer this
question do you like ice-cream on a one to five scale? If you are a rational person -- you all are -- you would say maybe it really shouldn't be 4. It should be 3. If only I had more points in between 4 and 3 so I could be a little more discriminating. What if I put 2 Xs because I like it for desert but I don’t like it with pancakes and sausage for breakfast if it's coffee ice-cream? That's the way in which raw data is an oxymoron. When we design the survey item, when we position it among other items, if we attend to that, it matters. It's not raw data. It's already imbued with particular notions that we have as the designers of the instrumentation as to what it means. So here's trace.

Remember this. The theory matters.

So my example about highlighting or underlining that you do tells me something about this operation. You are discriminating something. I know which information you've operated on. There's a record of it that's recorded. nStudy records the information that you quote as well as where it came from, the time that you did to approximately a tenth of a second and whether you added any other information to it like a hashtag something or other, find out. And let's not forget people do things for reasons that is they are motivated. So when you are making these discrimination, I have a pretty clear trace that something is motivating you to first of all mark the text in some way, perhaps to mark it in particular classes, maybe identify it by those hashtags and maybe the amount of marking is a reflection of for instance your efficacy expectation.

If you ask learners why did they highlight text their first and very practical answer is so I don't have to read the whole chapter when I cram the night before the exam. Their motivation is to compress all of that material into the nuggets they think are going to be on the examination that they're going to be taking. There's motivation. That trace, as bland as it may look when it’s shown on paper or appearing in the database, tells me something about what that learner is motivated to do. Interpreting what that is is a little bit more of a challenge. So here are some examples. I've already gone through this one. Planning to review. Why else would people mark these things unless they plan to review. Well there is a possibility. It could be that and this is one of the experiments we're just about to run this summer. Why does highlighting work? There are two explanations. One is the decision making that goes into selecting this versus that is what matters. The other is as you highlight it you draw your eyes across that material and rehearse it. And rehearsal is a powerful tool for getting information into memory. Maybe it's rehearsal rather than decision making about discriminating this is from that and the material. Quoting and annotating. Again, your meta-cognitive monitoring occurs anywhere. Anytime You do anything you've monitored in some degree the you're going to do the next thing. So here are descriptions that I create when I get a datum in the database that nStudy records about your studying with the software. So if you're copying and pasting a note that you made three weeks ago into an essay you're constructing about life on Mars, you must have monitored what you think you know to find that note. I might get an expression of how you're monitoring that by the expression you enter in that search field. What are you using as the triggers to locate whatever information you've got about meteors as seeds for life. Now I'm getting a trace about your recollections about your prior knowledge and the way you think that knowledge that you have is connected with something and what is it connected to, it's connected to the note that you copied and paste into the essay that you are building up. There's some more. Some of these are a bit tenuous so for
instance do I know that you rehearsed the schema when you are selecting a particular note template? Not directly. But I'm assuming. Here's the way in which raw data is an oxymoron. When you are filling in an explain note and you're going to describe the limits of this cause and effect system, you read the label limits in order to figure out what kind of information to put in that text box. Otherwise you'd be writing your favorite recipe or a phone number or who knows what.

So, when you fill in that text box, I make the determination, you have decided this is a limit for this explanation that I'm characterizing. How true that is is an open question. Everything that you in nStudy generates a trace that I can interpret. Whether my interpretation is valid, well of course I'd like to think it is, but that's what the research will tell us. So I'm using this buzz phrase these days -- big data. Why is it big? Well one of the attributes of big data is that there's lots of it. Think about how many traces of your studying activity I would have if you were taking a chemistry course. Your textbook is online, your lab work is, projects are online. You construct the products of your lab work as well as study materials that you might share with your group in the chat environment as you are working in a study group. How many data do I have about your studying over semester? I don't know. But I'm going to guess it's probably going to be in the neighborhood at least the tens of thousands. That's pretty big. Now multiply that by, how big are your introductory chem, chemistry courses?

WOMAN: Thousand.

PROFESSOR PHIL WINNE: Pardon?

WOMAN: A thousand.

PROFESSOR PHIL WINNE: Okay, a thousand? Okay. A thou. Let's do this with an exponential, you know. It's going to be big for the chemistry course. Now let's take to physics and psychology and sociology and economics and English lit. Even ed psych. It's big data. It's not one MOOC. But it's a whole bunch of little MOOCs going along. It's very grained. Everything that the learner does is recorded in nStudy. Time stamp I can track to about a tenth of a second how this plays out. And it can be in the wild Internet or in very structured environment that you provide for your student through your learning management system.

So John Donaleski and his colleagues recently published this really nice article that assembles this collection of tactics all having a history in learning science, all demonstrating to some degree either benefit or not. In fact, the purpose of this article was to bring together in close to meta-analytic way what the findings were. I need to write John and tell that he got it wrong about this because he and his colleagues said that highlighting wasn't effective but they hadn't gathered together all the studies. We found about twice as many studies as they did and the meta-analysis we constructed showed a positive benefit for highlighting.

Again, on average. So these are the things that we could take as fragile hypothesis for individuals. Distribute your practice. Spread out study activities over time. Use a key word mnemonic. AEIOU is a keyword mnemonic. ROYGBIV for the colors. Is violet still a color? I heard that they took that off, just like Pluto isn't a planet anymore. Highlighting, summarizing, self-explanations. Self-
explanations getting a lot of good press these days in the experimental literature of learning science. These are all things that we might recommend to learners. How do we get a learner to self-explain? We give them a note template called explain note. We watch how they use it. We encourage them to use it or we make them use it by assigning points to it or however you want to explore that. In the feedback data we look at the data as instructors and so on. So this is an intuition I have, not yet demonstrated. We talk about learning strategies. A strategy militarily is a larger approach to dealing with various tactical arenas or theaters on the battlefield. Tactics have steps themselves. So highlighting would be a tactic. Find information that helps me explain something understand. There's a bit. There's a bit. That's a tactic. Put highlighting together with something like summarization, let's do this take search, find everything that's a quote that might be about a particular topic.

Now I've got a summary of that. Now let's paraphrase that as the summary per se. Will that work? Experiment. Find out. Does it work for men? Does it work for women? I don't know why that would matter. Does it work for people with low prior knowledge. Do you need a certain level of knowledge in order to select the right materials. So forth and so on. So anyway. Here we have a sequence of events. Highlight. View. Add to the summary. View another highlight and so forth. We can construct, it's called various things in various disciplines, transition graph is one of them. I started out in this, doing this thing so I'm on this row. What do I do next? B? Put a tally there. Now I'm at state B so rotate around here counterclockwise. I'm in row B. What do I do next? D. Put a tally there. No I'm in state D, rotate down to here. What do I do next? I've lost. And B. Put a tally there. Read this sequence into this graph. What does it tell you? It says when I'm doing this I'm twice as likely to do this as I am to do C. We can draw a picture of that learning strategy. We can describe the conditional probability that given that do this, what do I do next? Given that I do this, what do I do next? Or here I just do D. This is not a very complicated example in the sense that the number of things that are recorded in the sequence is small. It's just for illustrative purposes but you could imagine even over the first four weeks of a semester, how you could use a procedure like this to characterize how do you study. Quote. Quote. Quote. Quote. Quote. Quote. Quote. That's what undergraduates do. [Laughter] Then search for some particular thing. Okay, does that work for you? Great. What's the picture look like. Very simple. Quote. Quote. Cycle back. Quote. Cycle back. Quote. Summarize. If that works, great. But you can show a person a picture without letters, with actual descriptions about what they're doing. Use the language that nStudy provides. Teach them a way to talk about what they do as studiers. Here's your learning strategy. How's it working for you. What would you think about changing? Do you really need B. Or could you, is E really critical for something? It provides the beginnings of a way for the learner, or an instructor or a researcher like me to hypothesize how can I make this better. So what we see is that A is a trigger for this. And later on we might see a more complex collection of events being a trigger for exactly the same thing. What might be happening here, the learner realizes just quoting wasn't good enough. What I need to do is quote something. And then I need to look up the terms that are in the quote that I made that are part of the glossary and then I can go off and do this. Occasionally I can go over here and I just stopped at that point. We can show pictures of this sort saying you know your learners, your learning strategy is metamorphosing into something different. Whereas you used to do just this, you've done this.
And this path ends up being the gateway to this activity. If this really matters, notice you've become a little more, shall we say, detailed, inquisitive, creative. We don't know until we look at what those particular events are. So we can see the roles that events play as elements of tactics. The ways that tactics assemble and a larger structures called strategies. We can look at the correlations for an individual learner or about whether those tactics or strategies matter in terms of do I attribute my results to effort about which I can take pride if I succeed and if I fail or don't do as well as I wished, maybe more effort is the key. This is what you can get from most learning management systems. You know when a learner logs in, you know what they look at particularly if they open up this document you've given them or a bookmark you've lodged there. If there is a form or discussion feature in that system. You know when they log in. You do have a complete record of all of that. This is the stuff that nStudy was designed to gather along with more that I was showing you including things I haven't shown like our video annotation tool, our concept mapping tool and so on.

All of this is that very fine grain material that generates the big data that lets me characterize as fully as possible with this instrumentation what the tactics and strategies are that you're using to learn. This is building on work that we're just launching at the moment, potentially in collaboration with some colleagues at Arizona State University and Danielle McNamara is there. Danielle is a student of Walter Kintsch's. Walter Kintsch was one of the primary figures in describing human memory and the way in which reading comprehension develops as a memorial construct. Danielle develops intelligent tutoring systems. iSTART for reading, Writing-Pal for writing. And one of the main elements that she has from a computational linguistic point of view is methods, machine classifiers and other cool sounding things to run through text, for example, and identify here's a section where they're debating or here's something where they're explaining. This business up here is something that i've been intrigued with. I call it a term net. Terms are the building blocks of a discipline.

So if you look in the back of almost any introductory biology book, there are about a thousand or twelve hundred terms ranging all the way from amniotic fluid to cell wall to you pick it. The same kind of things characterizes many other kinds of textbooks. Those terms have relationships, one to another. You've played the dictionary game. You look up a word like sinecure. Anybody know what sinecure is? It's very. Either I guess you'd say low on the old list of the Standard-Binet Intelligence. It's a job that really has no responsibilities, what we'd all hope for. So, you could understand a job with no responsibilities but if you said to a grade six student what's a sinecure, their look might say I'm not sure what responsibility is. That's in terms of relationships. Then you have to look that up and you may end up looking other terms to figure out what that means and so on. You can construct a graph, a node link relationship, a mathematical graph showing that.

You can extend those notions under the assumption that authors are considerate in what the philosopher Grace called so that for instance, I don't tell you more information that you need to know. I tell you all the information you need to know. So if I write a sentence that's actually coherent and makes sense and there are two terms in there, there's some binding of those two kinds, those two terms. I don't know what the binding is but I do they go together. We can construct that way. A paragraph is a larger compendium of a collection of these terms and we can look at that in two ways as a graph of sentences co-currents or just a graph of the terms. This
is a way of characterizing information structures and it may have some benefit. May, I underscore may. We don't know yet. We have tried to look at that sort of information that learners study so we can say if you use this kind of learning strategy, when the term that has this kind of structure, like a timeline, you probably ought to be using a first letter mnemonic. Like ROYGBIV which may have, some of you will know but not everyone tends to know that that's also alright in terms of the wavelengths of the light colors -- red, orange, yellow, etc. So that's why it's a sequence. We can begin to give learners some feedback that says when you come across a sequence, try a first letter mnemonic like ROYGBIV or EGB, every good boy does fine, EGB -- whatever it is.

[Laughter]

You can see why my music career didn't go very far.

[Laughter]

In addition, well for a bunch of other reasons. So. We're exploring some notions about this to meld the information and the structures that information has. Some of it just in the very nature of the meaning of the words and others in rhetorical devices and designs that apply to the words so that learners can explore the possibilities for thinking about that information as well as the way they study. To put it shortly, learning skills is not just about the skill of learning. It's also about knowing which skill to use when. That is how to regulate. So we could do things like this. So these illustrate some of the lists that I borrowed out of Lofsksi's article and that table earlier. Here's about its actually mixing two things. One is the spacing effect about schedule for reviewing material and the other is called retrieval practice effect which again in the group context is demonstrating that actually trying to remember the information over just looking at it again. And here we have an opportunity for a learner to test somewhat like that objectives button I mentioned before. Did I use these terms in my notes? The idea here is most people don't write notes to themselves that are gibberish. They usually include the language of the discipline, you know oxidation reduction, symbiotic etc when they think they understand that information unless they are explicitly annotating what does this mean. Which we can identify by some linguistic markers in that text.

So we could separate out those notes and say okay, now we have some sense about the learner potentially having learned particular terms today and again looking for correlations between notes taken with terms, adding in for example some of the structure of the terms, to give even more penetrating ideas to learners about experiments they might carry out. We can look at chats. So we can bring together what's in that purple who chats with whom. There is a big interest in the learning analytics community for social network analysis. Interesting findings coming about for instance people that are most engaged that are hubs for information end up learning the most. We're not exactly not sure why that is. Is it just that they were just rehearsing all of that information in order to have these conversation with many people. Is it because they end up having to explain things to people and the self-explanation that the learning science literature promotes. We're not sure about how that happens. But we can meld IT with also about the resources they're using. So we can get some sense as instructors, not only about this is an unpopular resource and this is a popular one but the unpopular resource actually ends up playing
an important role in the social discourse, even though it's consulted in the first place only by one or two people who may play the role of a hub of disseminating that information in their own words. In other words, they are translators to the rest of the group. Thank goodness. I'm wrapping up. [Laughter] So these first three bits hearken back to what I tried to set up in the beginning. The self-regulated learner, the robust learner, has knowledge of the domain and of ways of engaging with domains to learn. They need to develop that knowledge into kill, just knowing it is not enough. Those of you that play a sport, golf, tennis, pool, whatever it may be.

Sadly we all know what to do but it often comes out as a slice or whatever it happens. We need to work those together into functioning skills. The same is true cognitively. And we need motivation. We can't ignore that. The classical experimental findings offer little help when n equals me other than to suggest ideas that I might play with as an experimenter. We need data. I need data as a learner about how I'm engaging with that information. So does the researcher, the instructor. The opportunity is that big data, when we look for clusters of learners that have a profile over a very large spectrum of variable, motivational, study activities, prior knowledge, add whatever demographics you're interested in, in that very large data set, maybe larger than CSU, let's take all of the state of Colorado, let's take all of the Western states. There's going to be statistically, with great probability, a cluster of learners, who is working just like me say one thing who is more motivated, learning more, learning faster, whatever the value outcome is, you can suggest to me based on that empirical finding, even if we have no clue about why it's working.

Why don't you try this? And every learner gets to participate. And we also get to trace whether the learners go back to the classical experimental language, have treatment implementation validity. Do they engage the way that we nudge them? Do they adapt it? Are they self-regulating, maybe in a self-handicapping way. Or in a productive way. We can take all of that data and modify the close findings we have at the group level from learning science, to say now, instead of trusting random assignment to rule out all of the individual differences that other elements of learning science say matter, I can take advantage of them with big data. And hopefully this becomes an accelerating cycle where we feed learning science, learner's doing their own things. They are trying new things. We are feeding. You can see where this is going. So you can see it's a big group. Hundreds of thousands. MOOC like size. But the neat thing is it doesn't have to be just one course. We can discover whether learners who study in a particular way in chemistry compare to learners who study in the same way in an English lit course. I mean is understanding oxidation reduction reactions at all like figure out the Capulets and Montagues are doing what they're doing?

Model all the facets that are involved as best we can. Remember, raw data is an oxymoron so we're going to need ourselves to be flexible and creative in thinking about how are we going to extend what nStudy is now and other tools like that. This point I think is lost in the literature about learning strategies, except it isn't. In the 1980's there was a lot of work done in reading comprehension strategies, particularly with upper elementary students and what they discovered was it was important to give a reason to the students about why they were doing what they were doing. Why they were looking at the section headings. Why they were doing an Oh I wonder learn strategy? What do I know already? What would I want to know or wonder about this text and when they get done with it what do they learn from it. It wasn't enough to say just do these steps. You had to convince people that there was something -- reason -- for
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doing this sort of thing. They need theory language to do that. It doesn't have to be sophisticated as you might find in a journal like the Journal of Educational Psychology or Learning and Instruction or whatever. But they do need some language to talk about it so they can talk to themselves about it. And the neat thing about this idea of using nStudy and Canvas and other kinds of tools, along with the data you'd collect outside these electronic environments and hopefully merge with it is that it could go on forever. Imagine being able to help a student starting September 2 or whenever the term begins here at Colorado State. On the first day, they arrive all the way through to the second to the last week of their senior year. So the idea here is about a community of practice and an ecology of experimentation. Let's think about everybody in the community practicing a view about learning as being self-regulated, both productive and sometimes not productive.

Let's help everybody have the information they need to think about theorize, revise hypotheses, test hypotheses. Let's construct an ecology. Let's hope there are not too many predator prey relationships in this ecology in which this is ubiquitous. What's going on every day is an investigation of a very gentle sort about what's going on in learning and how it might help. Yeah.

WOMAN: So that learner from September 2 to December 15 are they getting data continuously from nStudy or at the end is provided by the instructor.

PHIL WINNE: We are shortly going to be extending our search. I illustrated search only with respect to the content of words that are in the webpages you've seen and the notes you've made. I want to construct a controlled language. So I could ask a question as I showed in that one slide -- what notes haven't I reviewed for at least two weeks that are about this topic? And just like the chat environment where there are some starter prompts, we'll start with, you know, we'll get some people into our lab, we'll give them some experience with nStudy. We'd say. Probably teach them a little bit about how to ask questions about their studying and say, what are you interested in. We'll take those as a starter set.

Then we'll monitor because we record everything. What those learners we'll say, okay, take nStudy and go out and, you know, you happen to be in this class most materials are online, would you use nStudy for us? We'll watch what they do. We'll also then scan learning science in the regular literature, add more, the idea being can we construct a help, a tool so that learners think about what kinds of questions they might pose about their studying activities that nudge them along, don't make the gap too wide between what they're doing and what they're comfortable doing with what they might do next.

WOMAN: Can we get data about how students are doing, students who are doing well, students who are not doing well?

PROFESSOR PHIL WINNE: Yes, we have another piece of software that's a little bit in transition at the moment that's essentially relatively easy way to develop surveys and achievement tests of multiple choice and other sorts and I'm hoping to collaborate with people like Daniel McNamara and Art Graesser at Memphis and others, who have some very sophisticated ways of scoring essays. That. So we can get at those kinds of questions again in the
large context so that whatever course that you or your colleagues might be teaching here, we could look for matches in data that might be coming from Iowa State or UNC or Penn or wherever. So the idea here is let's create a community of practice where the community consists not just of us saying to learners, hey try this, them telling us this is what's working for me, this is what I'm trying, here's how I'm adapting what you're telling me to do. Thank you.

[Applause]

Yes.

WOMAN: So as I listened to you I thought about all sorts of words and in chemistry, as you are aware, words are only part of the learning process. There are lots of equations and symbolic representation of things. I don't see how nStudy, I don't see how that easily works into nStudy. Have you thought? Or have you? How do you?

PROFESSOR PHIL WINNE: Yeah. We have a workaround in two hopes. The workaround is that every symbolic expression usually has a caption and that caption can serve as a reference for, you know, the symbolic expression. We can select the text. The challenge is that in the HTML environment, the figure itself is just a collection of pixels. So what we're hoping to figure out is some method whereby we can allow for instance a learner to marquee or lasso a set of those pixels that represent something in particular and then through a note form saying what is it that you selected, so that would be one of the first elements of the schema or the web form that's there. So the learner is saying, I think there I've selected dah, whatever it is.

The other thing is for some expressions, you may know there is MathML, the math markup language for HTML. It's not very robust and so if matures sufficiently and then we're able to tap into it then we maybe able for expressions to be able to you know, you circle the exponent or something like that. Quote the exponent. But that's, you know. I don't have the resources to get the entire community to set a standard for MathML that will work for nStudy. They're not interested in that in the first place. So the workaround is just work with the caption. In any "good" text, every figure, every graph, every expression does have a caption. We can prompt the learner to tell us what they think they are referring to within that. So, for instance if it's a picture like that self-regulated learning model, I showed in color before, I could say okay I'm talking about the goals and then proceed from that point. It's not as great as we would like but it's the best that we could do at the moment. Yes.

WOMAN: So what's currently in place to design [inaudible words] student learning strategy and to sort of call out to that then the strategy to mimic others who are successfully, you find others in the network who are successfully doing the same kinds of things.

PROFESSOR PHIL WINNE: That's, umm, some large portion. I'm not quite sure of the exact percentage of the approach. The other is, nothing would stop and in fact as a learning scientist I would like to make some suggestions to learners to do things based on what I'm observing that data I think is of possible benefit. So there would be experimentation that would be happening that would originating, the intervention originating with me and two important
questions -- what happens when you put that out into the world? Does the learner change it? The treatment implementation question that I think that an experimental psychologist or program evaluator would have. And if so, how, and what are its effects. And assuming that it doesn't get changed in too much of a way, what multiple kinds of effect does it have. Again, the issues about learning the content that's being studied, the method of the studying of the content and the motivation that relates to those things altogether.

WOMAN: And those outcomes are based on students' grades only or so that's the question sort of

PROFESSOR PHIL WINNE: Ah.

WOMAN: The link I think I'm missing.

PROFESSOR PHIL WINNE: Okay. So. Grades are important. Every registrar will tell you that. Every scholarship evaluator will tell you that. It's way too gross a measure for me. So. Here's an illustration. If you three are in a group and Gwen knows content A and you know content B and you know content C, am I justified in saying that the group knows A and B and C? No. Well, yes. Well, not sure. Or if for example, you use a term in your note and I read the note and I see yes that's a correct use of the term and relating it to something else or explaining something or whatever but then you answer it correctly on a test. Did you learn it? Well, not by the classical definition of learning, a relatively permanent change in behavior as a function of experience. But there's some evidence that if I looked at a shorter time window, yes you did learn it. What was the issue with the test side of it? So we raise some questions about classical psychometrics for example whether of the old variety such as one of my advisors Lee Krombach studied or the new varieties like item response theory and other interesting things. What is a test item and how does it map to the content and what did the learner do the content and how does that map to the test item and if the test item is incorrectly answered can we figure out why, based not only for instance on the basis of that term net, is it just the thing that's in one spot of the term net or is something about the structure of the relational terms and how did you study those and does. It's complicated. We're not going to. I can't imagine in my lifetime that we'll dispense with grades but from the point of view of thinking about learning science at this individual at this clustered and in the more classical experimental ways we need to come to a much more sophisticated understanding about operations applied to which content with what effect across time. Across a term net or some other representation of content. That's the part that I'm trying to interest people like the computational linguists in wrestling with so because I don't know how to do that stuff. I hope I made that sufficiently complicated to.

[Laughter]

I'll let you choose. Let's see if I can navigate this like I

MAN: Why do I have to be first to use the microphone? This seems like it could be a useful tool to evaluate the learner. But what about evaluating learning. Ultimately that's what we're trying
to do. Does the student learn more by going through a process like this versus those processes we've used since there were stodgy old men in big theaters lecturing to people?

PROFESSOR PHIL WINNE: I don’t see anyone like that up here. [Laughter] Umm. First of all, if I can, I'd like to, I would say debate but I'm going to be more forward argue with you about using, about evaluating the learner. Learners are evaluated with respect to their content and if that content happened to be a course in learning strategies you could evaluate them with respect to learning. I'd much prefer to propose this as a way of characterizing the learner and characterizing learning. What I was just describing over here complicates some of the questions about what is it that a learner knows. And what I'm hoping to move forward is a notion that by better mapping what goes on during the process of studying and revealing and even the process of test taking. Imagine.

You could present tests as HTML and imagine the learners worked with those. As in, you know, I don't understand tag for a section of a test item. We could investigate, I think, in a much more deep way what's going on and with big data we might find conglomerates, groups, cliches in the social network theory language of things that seem to suggest yeah there's a coherent to this pattern of activity and it has pretty much these same results. Now whether we want to recommend people do that or avoid that, it would depend on what the result is. Am I answering your question or? Sorry.

MAN: No. To use your words, you are categorizing learning what the learner is doing.

PROFESSOR PHIL WINNE: Yes. MAN: But is learning improved for the content, for the subject matter, with this processes with other processes. Have you tested that?

PROFESSOR PHIL WINNE: We haven't tested that. That's yet to be done. I'd point to that first representation of robust learning borrowed from the Learn Lab that talks about the permanence of skills, the transferability and what old psychologists would have called savings for retention, a faster learning rate at future points in time, that would be three different lenses to use in judging whether a way of going about studying was productive. And we may find things where you get terrific acquisition and poor retention and transfer or the other way around.

WOMAN: One of the topics you talked about in setting up systems to help students become better self-regulated learners was creating opportunities for experimentation and safety to err. And my course is never set up that way. We have homework where I think that the way that we build homework and the points for it, um, gives a lot of opportunity especially in the particular system we use for erring but the rest of the evaluations are all very high stakes. So what I watch a lot of students do is have a process, good or bad, for whatever their studying is, take this very high stakes exam and then if they reflect, I think a lot of them are unsure whether they really have the opportunity for experimentation because their hypothesis is often that anything that I change that's unfamiliar is probably going to be worse. So, how do we, maybe we have to change assessments which is the way to do it but how do we think about restructuring classes to give more of that time for experimentation and reduce the threat of making those mistakes.
PROFESSOR PHIL WINNE: A radical suggestion.

WOMAN: Yes please.

PROFESSOR PHIL WINNE: Get rid of the tests. If they perform it in homework activities, fine. But what about if they co-operate with other people? How many? It sounds like you are working in chemistry. Let's say they are working in an industrial process to work with, for example, pasteurizing milk. Do they do that all by themselves? No. Well, what's wrong with having people working in groups, then to work on the homework? Of course the people who have award scholarships and grades are going to be very upset by this activity but it opens the opportunity for questioning some of the notions that we've had about the nature of and purposes of assessment. And I'm, I'd like everybody to have that debate. We may end up, I don't know where, which side or which other angles we might approach this from, sorry for the bad grammar but it creates the stage for us to say if people can do this activity, why do you have to have a separate test? My favorite example, um. We are. I'm sorry I forgot your name but we were having a little conversation before about chemistry and I have an affection for chemistry. Several centuries when I was an undergraduate, I won a prize in chemistry and I got a CRC Handbook.

[Laughter]

Why did I have a CRC handbook? Well, you don't need to remember all those things. You could look them up. It raises another question about do people still need to learn addition. We have phones that do this. Ok Google, how much is four plus three? What the curriculum is, is going to be open to query, I think. What matters? It used to be the case that you needed to know the atomic weights of things because there wasn't a CRC Handbook to look them up. You needed to know four plus three is seven. Fifteen plus twenty three is etcetera. What really matters? Are you interested in the new math way of thinking about you know arithmetic is just sets. So should we be teaching set theory, instead of arithmetic and then say, by the way, you can do arithmetic with this. Or a whole bunch of other things. I'd like that conversation to open up, particularly the one about tests.

If I can show you I can do something, do I have to be tested on it or is the test my homework assignment. And, again, in the real world, nobody sits there with no resources at hand anymore. It's not like in the renaissance. If you didn't have the knowledge here, or the very few tomes that were molding over here on your bookshelf, you needed to know it or it couldn't be done. The Internet changed that. There's a question way in the back.

MAN: I can holler out. It'll be just fine. I'm thinking about test as retrieval. Not test for the sake of grading something or evaluating whether you know it or not but encouraging someone to actually retrieve information which, I'm no brain scientist, but which I understand is what starts to create learning. Right? If I just sit there and I say well I know this without [inaudible words] and slept on it and osmosis. Sorry. [inaudible words] Cool. Umm, you know. It's somehow mapped itself in my mind. If I'm not asked to retrieve any of that, how am I actually mapping knowledge myself? If this thing is retrieving it for me all the time, is learning happening?
PROFESSOR PHIL WINNE: Good question.

MAN: So. Yeah. [Laughter]

PROFESSOR PHIL WINNE: But, what I would say is this. Again, umm, in the near future, we have this database of a huge amount of information about the operations applied to particular bits of information. And as a learning scientist, I like to engage is some experimentation by saying what is the, well, let me go, let me step back for a minute. There are two intervals that have been studied in relation to when you study something and taking a test. One is when you first encounter it. Then an interval when you study it. And then the interval from the point when you study it to when you take the test. And there's actually a rule of thumb that's based on not a lot of research that says it's roughly a 1 to 10 ratio. If you need to know something a year from now, after you first dealt with it, you should study it about a tenth of a year after that point and then on. Now, again this hasn't been worked out. We could play with that. So we could take within a learner across a subject area, just the terms or the principles or some applications of the principles and experiment saying send the message so we have an avatar who we've got lots of computation going on in the server side, an avatar that says okay here's today's challenge. Do you know the meaning of these?

And we pick those based on characteristics of the way in which the learner had operated on them over a particular set of time intervals. Find out for that learner, for this subject, maybe with the term that has this kind of graph theoretic structure. The interval's not 1 to 10. It's 1 to 5 whereas for a different theoretic etc. So you see where I'm going. We can engage in a lot of experiments, especially if we could you know. My hope would that nStudy might become as popular as Word or Powerpoint. And in that context, we would have enough information to be able to investigate this question. Of course we need to do that responsibly. We need to provide off-ramps for people who are taking a path that's not going to be productive. Just like in medical trials they'll say, you know, we've determined that this drug is not effective.

We're not going to continue with this anymore. Or the opposite. It's so effective that the placebo group is now getting the treatment. So, that's what I mean about the community of practice where the community is enlarged and the ecology of experimentation. Everybody is involved. The learning science at the learner level, the learning scientists at my level, the instructors who are whether they call themselves learning scientists, are still learning scientists, because they're making choices about how they are designing their curriculum and its modes of presentation and the homework and activities etc etc.

WOMAN: I'm sorry, that's all the time we have. Could you help thank Phil again?

[Applause]

PROFESSOR PHIL WINNE: Thank you.