Alright folks, well thank you very much, I’d like to thank Drs. Halpern, Graesser, and for the opportunity to present at the conference. Before I begin, I’d also like to acknowledge NSF, US Department of Education, and the Social Sciences and Humanities Research Council of Canada, and several other funding agencies for their support, and also my colleagues, grad students, and current and former members of my lab.

And, so what I want to talk about is what we do about studying learning in computer-based learning environments. CBLE encompass several environments such as simulations, hypermedia, and multimedia. I’m going to focus specifically on hypermedia…I’m not going to cover all of it, because I only have about 11 minutes and 30 seconds. So, to give you a very brief overview, what I want to do is talk a little bit about what we know and don’t know about learning and hypermedia, introduce self-regulated learning with hypermedia, talk briefly about the theoretical framework that we use from what I’ve seen here from when I was at Maryland, and now at University of Memphis in terms of analyzing how middle school, high school, and college kids learn about complex science topics, with hypermedia. I’ll talk a little bit about the research that we did in our labs, just very broad strokes, in terms of the framework, emerging framework, the research questions I’ll be asked, the results, and hopefully you’ll have time to go back home with some principles for fostering learners’ self-regulated learning about complex and challenging science topics with hypermedia learning environments.

So by way of introduction, very brief introduction, what I want to do is….most of this research has been developed by education technologists, and learning scientists, most of it basically is a-theoretical, which happens to be the first problem. They’re technologically-driven, so, you know, if there’s a science of learning there, we need to adopt a science of learning. And that means, what do we find in these research studies? Well, we find that, overall, students rarely develop a deep conceptual understanding of chemistry, math science, whatever they’re studying. In addition, for those of us who actually study processes that are employed during learning, is that they lack the cognitive and metacognitive skills. And those are two critical self-regulatory processes that we need and are examining with our research teams at both Universities. And also, what we attempt to do is focus on product. How much knowledge is learned?

In addition, so basically our model here is that this type of research shows that the potential of hypermedia environments may be undermined by students’ inability to regulate their learning. And, as such, what we see here………Maryland and now Memphis, is that we are testing effectiveness of different scaffolding methods, to see which ones foster deeper conceptual understanding of complex science topics with hypermedia. So what we’ve done is test several of static and human scaffolding methods during learning with hypermedia.
In terms of giving you a synopsis of ‘what is self-regulation?’ it comes from developmental psychology, cognitive psychology, health and social psychology, etcetera. But what I want to do is give you a synopsis of ‘what does it look like?’ When you given students the following goal--, ‘you’ve got 40 minutes to learn everything you can about the circulatory system’, what exactly does a student do? SO I want to kind of show you. First of all, they’re given a multi representational environment, they’ve got text, images, dynamics, static images, they need to make certain decisions. So what I’ve done here with the arrows in slow motion, is see that I may start with looking at the introduction, I’m going to look at the heart, I’m going to click on a hyperlink, which is anatomy, that’s going to lead me up to a diagram, but you know I don’t understand what’s going on here, its too complex, so I’m going to click on something more simple. I’m going to click on the picture on the heart, and I’m going to summarize all those labels, I’m going to try to learn all those labels. Its still too complex, let me look at clearer knowledge. So in going to make the decision to go back and look at the introduction and I'm going to start reading, but you know what, this is not really in sync with my goals. Because my goal right now is learn about functioning of blood through the heart. So what I’m going to do is go search, and then I’m going to come up to an animation in the bottom right hand corner. But because I am regulating my learning, I am monitoring whether my emerging understanding is correct or incorrect, and what you’ll notice is, I have made a decision to stop the animation, because it’s just too complex. And now, what I’m going to be doing, is I’m going to learn about another thing, blood. So I’m going on to another topic. So, basically, this will just give you an idea; it’s pretty complex. So once again to drive home the message, if we can have a science of learning, okay, then we need to bridge all the different communities, bring their theories, their models, their methodological approaches, to basically attempt to tackle some of these question. These questions are not only relevant to self-regulated learning with hypermedia, they’re relevant to text comprehension, reading comprehension, whatever the topic may be.

So, where do we start? Well, we started with existing conceptual and theoretical frameworks of self-regulated learning. So as a basis we have adopted Pintrich’s four by four matrix, and what we have is we’re making certain assumptions. We assume that students can regulate several aspects of their learning, mostly focusing on their cognition, motivation aspects, which we haven’t tackled yet, and behavior context. In addition, at a macro level, students have the potential to deploy certain self-regulatory processes. And those could be, at the beginning of the task, ‘I’m going to activate some prior knowledge,” “I need to have a planning goal,” “I’m going to be monitoring.” Some people talk about meta-cognition, well it’s not just about meta-cognition, it’s also about monitoring aspects of your motivation. ‘Am I getting bored? Am I disinterested? What am I going to do?’ So then you employ some control strategies. It could be learning strategies, such as knowledge collaboration, summarization, making inferences, but, it also helps to know your behavior. At the same time, depending on the experimental context, students engage in reaction reflection, which can involve schema, adaptation, or motivational researchers, who tend to focus on attributions (following learning or instruction). ‘So, for example, if I (as a learner) find that it didn’t do very well or that the learning session did not go very well, what am I going to attribute that to?’ So that’s the theoretical framework.
In addition to that, we’ve adopted an information processing model of self-regulated learning. So, of course, I don’t have time to go through the model, its purely cognitive, of course, there are some advantages and disadvantages, which I’m going to talk about now, but we’ve used this as a foundation for our work. And so, some of the issues related to this model is that ‘what are its strengths?’ well, its theory driven, based on a lot of schema theory, and John Anderson’s model of information processing theory (IPT), it also focuses on meta-cognition and cognitive processing, and its focus on control and monitoring are critical. It goes through different phases; it has basically four phases, it has feedback loops, which are important of course in any IPT model, and it’s described as dynamic and cyclical. Now, in terms of applying that to our research on learning with hypermedia in science topics, it has some challenges. One of them is cognition, I told you that we’re not only going from self-regulated learning but external-regulated learning, where you can conceptualize how a human tutor is seen as an external regulating agent, whose job is to facilitate a student’s self-regulated learning, because they couldn’t do it on their own. In addition, Phil studies the learning process of studying. Well, we don’t study studying, we study learning. And, at the same time, it’s a great macro view of self-regulation, However, in the last 8 years and after a dozen studies¹, we’ve been able to detect that from video of about 600 students’ self-regulated learning, that this control here…well, we actually have seventeen different strategies that we’ve detected, and eight different meta-cognitive monitoring activities that students can deploy when regulating their own learning. So, making the bridge to the CTL, which is our Cognition Technology Lab, we’re taking a theoretically-driven approach, we’re looking at the mediated self-regulatory processes, between the learner characteristics, whether it be young kids or students in college, medical students or nursing students, etc.), and looking at the many processes, focusing on the areas of self-regulation, converging both process and product data, which is very critical, and very few people want to do.

So here’s the first attempt at this emerging. So a student comes to a situation through using a computer-based learning environment, happens to be hypermedia, in terms of the learning context, we have some learning goals, either an experimenter set learning goal, or in a classroom, a teacher-set learning goal, instructional resources is a computer-based learning environment, and there are several feedback systems which we may decide to manipulate or not. At the same time, the student comes to the situation with several things, certain cognitive issues related to individual differences, such as prior knowledge, there are certain affective components which we have not studied yet, but several colleagues are studying at other colleges. The meta-cognitive and motivational issues are what we’re focusing on. So the last two are the ones we would like the focus on in terms of substantive research.

At the same time, there are usually certain limits, usually you have 40 minutes, there is a time limit on the learning, I have to say, what actually makes it more complicated is the computer-based learning they are using is a hypermedia environment, so its non-linear, there are multiple representations of information as I showed before, there’s a certain content-space, a lot of the experimental studies are looking at a space of maybe 300 words, that’s not going to be much, maybe a page and a half, two pages of text,

¹ You can go to our lab website (http://azevedolab.autotutor.org/publications_inpress.htm) to see/download our papers
we’re talking about 16,000 to 19,000 words, learned control, and then depending on the situation you might have some scaffolding or adaptivity.

In terms of our research questions, very generally, we look at prior knowledge, how much from pre-test to post-test, shifts within the models from pre-test to post-test, and then our bread and butter, which is the process. How do they regulate their learning? That’s very critical. We’re not going to have time to talk about the role of external-regulating agents, such as human tutors. We are currently building the MetaTutor, a web-based A.I. system to detect, trace, model, and foster adolescents’ and college students’ self-regulated learning about complex science topics.

So, once again, a very brief overview; if you’re allowed to self-regulate, and we’re talking about a student here, who is using a computer environment, with goals for instructional context, what we know is, they show huge gains in comparative knowledge, that’s great. The problem though, is when we look at regression analysis, is that their odds for actually showing any improvement in the models is not there. That’s a huge problem. In addition, the biggest problem is that they deploy not only fewer, but the less effective self-regulatory processes, which I’ll show you in a second.

So what do we know in terms of contrast? By contrast, when you have an external regulating agent, such as a human tutor, not only are you getting to see their prior knowledge, but here, their odds of actually shifting from a less sophisticated mental model to a more sophisticated mental model is certain more existent. And they also employ those key self-regulatory processes. So what I want to do in these last two minutes or less, is focus on focus on the left hand side. This is a partial list of what the good key self-regulatory processes are. So what do we need to do for students? In terms of planning, we need to anticipate their prior learning. In terms of monitoring, there are two very particular ones, ‘judgment of learning’ and ‘feeling of knowing’ which have to do with your own cognition and whether you understand what you’re reading, or looking at, or examining, and how is it related to your prior knowledge? You have to leave time for that. You have to monitor your strategies, and your personal and work goals. A lot of people don’t do that. We have clock, tell them how long, and we prompt them. It’s almost like, ‘oh, I’ve got five minutes left!’ so they hurry up and don’t use very effective strategies. In terms of learning strategies, this is a list of strategies for reading comprehension or text comprehension, one that is very unique to how multiple sources of information and text fit together. These are the effective ones, such as drawing the differences and collaboration, etcetera, and because there is a dynamic, several components of learning in a hypermedia environment, you also have to see about behavior. But we do not want students to over-rely on the human tutor. We’ve figured out that most don’t learn anything. So, these are ‘the bad ones.’ So what do we have, the recyclables in working memory; they keep repeating things over and over again, they’re using research, they take notes, they memorize, one of their favorite activities, and they often express, ‘this is really hard to learn.’ So, how do we use this in terms of computers and meta-cognitive tools, which is one of the new grants. I’d like to acknowledge my colleagues and fellow students. Thank you.