MRP Committee Meeting 1

**2015.04.23**

**Present: Gael, Mel, Erina, Jodie, Michael, Stuart**

**TIMELINE**

* **May** - Research Methods Class (Complete literature review and proposal)
* **Summer 2015** – Erina and Melissa continually meet with Jodie and Stuart
* **Fall 2015 -** 2nd committee meeting with everyone
* **September 2015 to July 2016 –** Coursework and actual work on MRP
  + Both projects a hybrid of 3D and interactive
* **July 2016 –** MRP completed and submitted

**ACADEMIC GOALS**

**Melissa**

* Alternate video games (ex. Games for Change and academic games)
* Higher education and PBL learning – what tools are effective for learning?
* Discussed undergraduate experience with different structured courses and projects
* Interest in VR and AR

**Erina**

* Molecular level
* had misconceptions coming in that she wants to address for student learning
* physical interaction with objects
* augmented reality

**COURSES TO TAKE/MATERIAL TO LEARN**

* Maya with Stuart in Fall 2015
* Jodie;s course - Preproduction for interactive Design
* Nick's course? - need to wait and see how much linear narrative there is
* Marc's course? - depending on how much animation there is
* Learn Unity, and some coding languages
* Once we have parameters for our projects, they will direct us to Online resources.

**TO DO/MOVING FORWARD**

* Send a link of Andrea’s game/project to Gael (looking at using games to teach students)
* Projects and people to look into:
  + Art Olson (Haptic Feedback)
  + Chris Dede at Harvard Graduate school of Education
    - EcoMuve - playing parameters - pond ecosystem
  + EcoMobile
  + GRC Meeting in May in Maine (August 2-7, 2015)
  + AutoDoc – David Goodsell has worked on it
  + McGraw Hill
  + Area 9
  + Learn Smart
  + Aleks
  + “\_\_\_\_\_\_\_” software knows based on analysis, when to give a fact because you have arrived at the point in your learning that it is helpful
  + Traditional books: Campbell, Strider, Lehninger - meaningful part of research is to get good sense of not how it really is, but how it is being taught to current students
* Meet continually with Stuart and Jodie in the summer
* Familiarize self with what is being taught in Undergraduate Biology
* Lit Review
* Erina – Can look at Vijay’s MRP project to see what he did with his simulation
* Go through Tree with Stuart

**SIMULATION – Melissa**

Elevator Pitch

* To design a molecular environment simulation that presents students with the ability to change the parameters of cellular processes (crowding, temperature, types of proteins, etcetera), and determine which method is effective in diagnosing misconceptions of molecular biology in undergraduate students.

Preliminary Learning Objectives

* Create a usable simulation that addresses simulation and design issues
* Determine other visualization aspects that need to be addressed from the literature review

Ideas, Brainstorming, Narrowing the Project Focus

* Control layers of pre-rendered images – is this too limiting?
* Does project need to be relative to existing animation?
  + Good to continue the story
  + Are we really missing out on anything from using the previous material?
  + But also want to give Melissa the opportunity to explore other possible avenues
  + Want to give Melissa the chance to explore 3D aspects instead of just using pre-existing materials
* Learning Objectives of undergraduate students: what are the key difficult concepts, where linear simulation failed to help with misconceptions, a user controlled simulation may help
* Let students identify the problem by adjusting the environment/parameter
* Add agency for simulation to see how it breaks the simulation? (Game-fication aspect)
  + Is simulation exists in real parameters, would we be able to address the misconceptions?
  + Another possibility: construct simulation like a game, but no rewards and no character : more realistic
* Are we targeting a specific audience and is it a good idea to stay close to their curricula and drive visuals towards that?
  + They understand the processes, but as soon as they have a job to do, they forget all of the learned material. If they cannot translate simulation to subject matter, there is no benefit to it.
* The previous review was brought up
  + To the reviewer, the subject of just binding was too simple
    - There are multiple phases but they are thrown out for visualization sakes
  + Need to do a better job of expressing selves when talking about distinctive phases of binding – be more careful of the language (we should come right out and say right away that there are different phases at different scales)
* Molecular Dynamics
  + How does this influence the nature of the simulation? One direction is to make real molecular dynamics from real data, and one option is to ‘fake it well’ using the tools – Maya’s dynamic tools where we have more control
  + What are the parameters we are hoping the simulation is trying to capture? What are opportunities for failure? What are parameters which we adresss these with?
* Why does everything have to be task oriented?
  + Set up scenario more like lab exercise to give agency
  + System provides feedback on what is happening
  + Participate in the science, even if faux science
  + Collect observations at the end and plot it to draw conclusions
* Give many opportunities to fail (ex. Let students play with parameter dials – free reign)
  + But issue with that is, if we set temperature to certain high degree, then we know there is binding, but does not say what is possible or realistic
  + We could have a pre-set observational setting (Relate how those dials are set to something that is biologically meaningful). Start with observation and then engage them in scientific process to let them explore.
  + Give students a real plot, parameters for some output and allow them to play with dials to match those settings. What happens under these conditions? Let them loose with dial, after having them experience known biological settings. Can you now predict settings that achieve a binding constant of X?
  + How about only giving them control of certain dials to be more realistic?
* Other possibility: 1) train students on the realistic settings first, after they see the effects and observe them, test them by:
  + Ask if they are predict so and so settings
* Sticking with what’s important
  + Ex) Diffusion
  + Want scientific connections that are relevant to curricula (first year Bio)
  + May be ideal to use in first year introductory bio course
    - Find very clear topics
* Integrating into Lab Manual
  + So students are able to directly make the connections
  + Have half of class exposed to simulation and half not - to see if this improves their learning and whether there is a connection
  + Breaking scale boundary to bridge the knowledge gap in lab setting (so not just mixing things in beakers etcetera)
* Concord Consortium – Molecular workbench
  + Are the claims made too strong, and are they scientifically accurate?
  + “Molecular dynamics” is used very differently by different people. (Molecules just moving vs. algorithms and everything in between)
  + We want to focus on 3D and images in the Concord Consortium may be too simple and 2D
  + When parsing through the literature, should familiarize selves with what people are talking about – there is a lot of literature there (almost make a meta-analysis)
  + Look at environments of where you can “do and fail” vs. being linear (open ended interactive environment through tweaking system vs. linear narrative). Need to fail to learn
* Early phase:
  + Look for what has already been studied. Different environment, doesnt have to be molecular
  + See what interactive models people have already made to approach similar questions
    - ecoMUVE
    - ecoMobile
  + Discovery learning vs linear storytelling learning
  + Analysis: gather literature for design ideas, the necessity to fail, etc

**ADAPTIVE DECISION TREE – Erina**

Initial thoughts and Ideas

* Tougher one - ripe with possibilities
* Always an option at this very early stage to abandon decision tree and have Erina work on completely different project

Ideas, Brainstorming, Narrowing the Project Focus

* Multiple paths through the tree that achieve slightly different scenarios. Can show how ridiculous some of those decisions made could be
  + Duo animation at each step, showing what is reality and what their thoughts are
  + OR show at the end, what they reached and what reality is?
  + Maybe multi passes, first pass through show at the end, second pass through show at each step
* What are approaches to remedy misconceptions?
  + Identity the misconceptions
  + Support as a teaching course to identify the misconceptions?
* For users:
  + Is being confronted visuallity a good starting point to fix misconceptions? Or does showing misconceptions lets the student build on top of it?
* Ask person to represent what they see visually.
  + Some ideas are easier to be visualized and misconceptions are easier to be identified
  + Other ideas are presented as visual analogies. Hereby the problem lay:
    - Are they finding the misconception because the idea is wrong OR
    - The analogy too ridiculous?
  + Ex) Vijay's project - look at different forces through simulations and then ask the students to create a drawing after simulation to see which ones more helpful
* Use of Analogies
  + Needproper analogy that does not become so obvious or ridiculous.
  + ex) cone of influence, tracker beam, spring that gets tighter and tighter.
  + danger in those visualization choices in terms of visual literacy. What is being visualized is a schematic versus illustration
  + they need to understand real idea behind that analogy
  + if too early on in their studies, it may not be effective
* The decision tree: will it be a separate tree from the base tree?
  + Learning is too self-contained?
  + Not a tool that supports adaptive learning by triaging category of students to be given different learning materials?
* Have amazing big tree that takes them through entire curriculum (too ambitious for MRP) OR stick to small learning objective
* Need to determine which misconceptions need to be addressed and how do you present those so that you can give students feedback on their ideas
* Provide alternate conceptions to students
  + What ideas can be visualised and from pedagogical perspective?
  + Create adaptive tool
* ANOTHER APPROACH :
  + Present a statement and a choice of representations.
  + Have students pick representation/visualizations instead of other statements
    - What kind of meaning will we find in these results?
    - Do they understand the problem, and what are the common misconceptions for us to focus on
    - Use existing representations from literature/animation to see how misconceptions are depicted
  + This can be a formative assessment tool or a learning tool
* Okay to talk about bad examples since they exist somewhere already
  + so might as well pick depictions that are representative of the way people have already tried depicting the environments.
  + But might be self-fulfilling prophecy? 🡪 That is not necessarily true, because asking more than one question.
* The visuals are the remedies provided at the decisions forks. Maybe they can navigate something instead
* How will tool be used?
  + formative assessment tool
  + stand alone tool to remedy  misconceptions at right time
  + can be used as teaching tool
* Have not defined subject matter scope yet - need to define at some point
  + want learning objective to mirror that of simulation
  + so can look at 2 different methods to compare them
  + write them out and see what boundaries are and make sure not to go too far
  + these are complex, multi layered misconceptions
  + tree has potential to tease apart the issues (where picture to learn does not have ability to do that)
* More work and decisions left to complete for Adaptive decision tree
* analogy of crowded airport - can you experience it as a person that embodies molecular environment?
* Learning objectives: same to Mel’s project in terms of what common misconceptions we need to tackle
  + Figure out how the tree should unfold. Pick statements? Or pick visualizations?
  + Learning objectives should be defined carefully.
  + Someone should plot the data from the current tree and see if there are any patterns from the set.
* Literature reviews: Same as mels and:
  + Scaffold/adaptive learning
  + Biology of misconceptions
  + Visualization and learning
  + Adaptive learning
* See what existing learning tools are already out there
  + Do a survery of the big topics: how are the current teaching tools (books) depicting them? How are they taught right now?

Molecular binding: another topic.

Possibility of incorporating AR using physical models

Likely a separate MRP topic from the deicision tree if going forwards.