GNG1103

Prof. Emmanuel Bouendeu

Deliverable C

Group F2

Lauren da Luz 8805144

Lauren McDermaid 5256108

Karly Piro 8584926

Dennis Sun 300111813

Maude Tremblay 8862732

February 9, 2020

Introduction

In this document, many concepts have been presented and evaluated. Each team member will generate at least 3 concepts and present their concepts to the team. The ideas are then evaluated based on the target specifications and design constraints using a selection matrix. They will further refined using our list of prioritized needs. Three final group concepts will be created based on the score given in the previous steps. The final solutions may contain elements from other concepts. Finally, the 3 final concepts are merged to form a final global concept.

Group Concepts:

Obstacle Course

Scenario

- Outdoor obstacle course similar to the television show Ninja Warriors
- Announcer goes through an overview of the obstacle course
- The user will have the opportunity before had to select the topics they would like to study
- Each obstacle will have the announcer in a picture-in-picture screen to help where needed. The player can take a short review of the material before completing the task but it adds time and deducts from their score.
    - There will be a tutorial version where the player can complete the course with mini lessons before each task.
- Obstacles would relate to the phase of the product. Ex: a liquid product would have an obstacle requiring the player to go through the liquid either side climbing a waterfall of the chemical, swinging from monkeys bars through rain
    - Must identify proper PPE
    - Identify pH, pKa
    - Bonus: if the chemical is hazardous, is there a way to neutralize it?
- If the player answers wrong, they will be hit with a giant q-tip and break into the molecules of the reactants. The player will materialize at the last checkpoint
- Obstacles alternate in size and time proportions. If a player answers a question wrong and the obstacle was to be completed at the macroscopic level, it will now be completed at the microscopic level while making contact with products in motion.

Achievements

- There is a timed component so the player can beat their time or anothers. Ranges of time would be associated with a grade level.
- The student must respond correctly to continue or risk being set back. Incorrect answers also reduce the number of lives.
- If the player loses a life or all lives, an option will be given to repeat the tutorials for material answered incorrectly. If they wish to continue immediately, they must complete the tutorials. If not, the option will be provided but optional next session. The student has the choice to use other study methods.

Testing Methods

- Each obstacle may only be completed when the player has correctly completed the task.

- The player will respond from a list of options (multiple may apply - matching). These options may vary in difficulty and appear more similar as the player improves their knowledge
- Players may also be required to answer with the chemical formula. Options of atoms and quantity. They may also build them in a model form.

Classroom Setting

Scenario:

- Chemistry classroom with chemistry equipment
- Have a teacher or instructor in the classroom who introduces the scenario and guides the user
- Various tasks on the chalkboard and user is required to select one to start a game
- Some games are set up similar to typical testing activities such as matching, multiple choice, true or false (trivia). Each time the user completes the task successfully they are given achievement points
- Other games are more hands on and immersive with the purpose to assist the user in learning

Achievements:

- Tasks that are time constraint orientated: achievement is given if task is completed within the time limit
- Tasks that are answer based: achievement is given if the user provides a correct answer
- Tasks that are completion based: small achievement is given for completing the task (this would occur more in introduction and learning scenarios)

Testing Methods:

- Each task is associated with a game or hands-on learning experience
- The user is tested based on regularly used testing methods in academia such as multiple choice, true or false and matching

Storyline

The third option chosen in for a preliminary concept was a scenario concept.

Scenario

- Wake up and have to get to your 8:30 class on time
- Go into the bathroom and have to complete several tasks in the bathroom to be ready for the day
- Sample Activities:
    - Wash your face - reaction with the soap and your skin
    - Put on some lotion - reaction of lotion with the skin
    - Take your medication/vitamins - reaction of medication in the body or could be water soluble
    - Brush your teeth - Time for individual reactions vs. the two minutes recommended to brush your teeth
    - Mouthwash - Reaction with your saliva and the germs in your mouth

Achievements

- Complete it in the time (to get to school on time)
- Feedback on your answers to various tests
- Running out of time means you did not learn what is required and will have to try again
- Completing all the tasks in the expected amount of time means you learned the concepts

Testing Methods

- Matching the reaction that you are about to perform to what will occur
    - Correct answers will result in no additional time added
    - Incorrect answers will result in additional time being added
- Question could be asked before the reaction occurs
    - then a side-screen will appear in the view to show the reaction in the opposite view (macro/micro) of the current view
    - The question will be reasked if the question was answered incorrectly
- Put two medications either in human esophagus or in water and guess which one will take longer to dissolve (for the reaction to occur), have them side by side so it's a “race”

Selection Matrix

Table 1.0: Functional Needs Decision Matrix

#	Design Criterion	Importance	Obstacle Course	Classroom	Storyline
4	Multimedia learning effectiveness	3	1	3	2
5	Communication between user and software	4	1	2	3
8	Ability to view macro to micro relation	4	2	1	3
9	Understanding of macro to micro relation	4	1	2	3
10	Ability to relate time to reactions	4	2	1	3
Total			27	33	54

Table 1.1: Non-Functional Needs Decision Matrix

#	Design Criterion	Importance	Obstacle Course	Classroom	Storyline
1	User-friendliness	4	2	1	3
2	User Adaptability	5	1	3	2
3	Scientific Accuracy	5	3	3	3
6	Respect of chemistry colour conventions	5	3	3	3
11	Appropriate Classification	5	3	3	3
Total			58	64	67

Global Concept

The finalized global concept was chosen based on the decision matrix that addresses design criteria developed based on the clients' needs. Out of the three final proposed concepts, the storyline scenario is the clear winner in the functional and non-functional needs design matrices. This scenario will clearly embody a majority of the learning outcomes and will provide an immersive experience that a user can relate to. A 'storyline' that relates to a person's everyday routine will assist the user in learning via the personalization and modality learning principle. Games and lessons within the scenario will provide a learning experience for the user via the rest of the twelve learning principles, mainly the coherence and segmenting learning principles. This global concept follows the third proposed design concept and will be implemented accordingly. No further changes or adjustments to the concept have been made.

Conclusion

After analysing possible solutions compared to our target specifications, many concepts were eliminated. Three potential concepts were selected to be examined further and a final global concept was made by combining various features of the 3 concepts. The final concept uses the storyline concept as the base and includes elements from other designs that did not make it to the top 3. While those elements were deemed to be optimal for certain situations, they were incomplete on their own. We will continue to evaluate the performance of the current concept in the future as we develop the concept further. In the following weeks, we will commence the prototyping and testing phase.

Appendices: Individual Group Member Concepts

Appendix A: Concepts by Lauren Da Luz

Concept #1: Time and Size ‘Dial’

- The user is to turn the dial in order to ‘turn-up’ or ‘turn-down’ the level related to size and time
- This game assists the user in understanding the order both the size and time aspect by placing certain objects or scenarios in order

Concept #2: Match Game

- User is given objects/scenarios on ’cards’ and is told to match a value to the card
- The user is celebrated when they get a corrected match and told to try again when they get an incorrect match
- This game assists the user in understanding the order both the size and time aspect by memorizing the associated values to each object/scenario

Concept #3: Slow and Steady Wins the Race?

- The user will have a bank of scenarios available to choose from
- The user will select any scenario in the form of a race car and place it on the racing track
- Once the user presses play they race will start. Since each race-car is based on a reaction speed, the race car that finishes first will be the fastest reaction relative to the others on the track
- At the end of the race a winner will be declared and the user will be given learning points about the selected reactions
- This game assists the user in understanding the time aspect by comparing real-life scenarios

Appendix B: Concepts by Lauren McDermaid

Concept #1: Environmental Macro to Micro

- The individual is outside in nature near a body of water.
- The individual throws items into the water. Ex: potassium, sodium, or pollutes
- The individual observes the reaction at the macroscopic level and zoom in to the microscopic level to see the molecules interacting with the water to show the movement of molecules, speed of reaction, and probability of reacting

Concept #2: “Alice in Wonderland”

- The individual starts at the microscopic level surrounded by moving particles. They must identify to atoms and/or compounds correctly for the character to increase in size. Ex: starts in crystal structure
- Once answered correctly the individual receives a cake that increases them to a size where they can hold a molecule in either hand. They then try to cause two molecules to react. They can guess the type of reactant, solvents required, probability reaction, and the chemical formula.
- This process continues until the individual has reached regular human proportions where they will receive their report card for the game. It will say what was done well and highlight concepts that should be reviewed.

Concept #3: Ninja or Whip Out Obstacle Course

- The individual would have to complete an obstacle course. The course would look similar to that of the Ninja Warrior television show. Each obstacle would have a chemistry related problem in order to pass the obstacle. If the individual answers wrong they are knocked off course by a giant q-tip and sent to the last checkpoint.

Obstacle Types	Challenge	Physical State of Primary Product
Climping, ladder. ropes	Identify the reactants and their quantity. Include any required solvents and their quantity. State probability of them reacting Proportionality and time: shrink and do obstacle side by side in time with the reaction. Size in comparison to obstacle	Gas
Jumping across pillars, side wall climb across a waterfall	Does the reaction resolute in a precipitate? Shrink to the size	Liquid

	of the precipitate to do the obstacle.	
Hit, punch, smash objects	Determine the probability and speed of the reaction - if right your score will match, if not, XX shows up.	Solid

Appendix C: Concepts by Dennis Sun

Concept 1: Item matching

- The player is presented with common real life objects with known sizes
- The player is then presented with different molecules or objects
- The player then needs to match the molecule with its correct real life counterpart
- The game elements can be based on the number of tries an player takes to complete the challenges. They can also be a decreasing score after unsuccessful attempts

Concept 2: Chemistry race

- The player is trying to run a race as fast as possible
- Along the way the player will stop and try to choose the shortest reaction
- They must hold the reaction until it is complete
- They goal is to finnish in the shortest time possible

Concept 3: A tour of campus

- The player will start on one side of campus and try to get to the other side as fast as possible
- The player will stop by buildings of a way and is presented a list of reactions
- The players will need to choose which reactions is shortest
- Once the correct answer is selected the player will move on
- This allows the player to rank which reactions will occur faster

Appendix D: Concepts by Maude Tremblay

Idea 1 : Macro to Micro
Different categories are presented to the user for different types of chemical reactions (Substitution, Elimination, Addition, Radical and Oxidation-Reduction).
They can “jump” (select) a category to learn about each type of reaction. In each type of reaction, the user will be able to perform the reaction and see what happens in real time in macro size. The reaction will then replay but the user will see it up close as a micro size.
To explain to the user what is happening, word bubbles will appear while a voice reads it out loud to them.
To ensure the user has comprehended what has happened, they will be asked questions about what they saw.

Idea 2 : Macro to Micro
In this situation, the user is faced with real life scenarios. For instance, as they are walking through a city landscape, they will be able to investigate “real-life” reactions that occur every day. These could include salt being thrown onto ice or someone walking with hot coffee or the hot dog man making street hot dogs. For each reaction that is occuring, the user will be able to “pause real life” and see what the reaction is in macro and then jump into micro. While the micro reaction is occuring, the user can also see a real time representation in macro with the use of a video bubble in the corner of the screen.

Idea 3 : Macro to Micro
This would take place in an actual lab setting. It could be a more futuristic version where the lab speaks to you to explain the experiments you are doing. The user would conduct a standard organic chemistry lab experiment so they have reference to what they see in class. The user would conduct the experiment as learnt in their labs and the reaction would occur in macro. Once the reaction is complete, the video will “replay” to now see the reaction in micro. This will occur as the lab robot explains what is happening.

Appendix E: Concepts by Karly Piro

Idea 1:

- As this is taught to young chemistry students could be a scenario where you have to get ready to go to your 8:30 class.
- To win the challenge you must be ready to go and out of the bathroom by 8:10.
- You start by washing your face, in this you have to make some bubbles then when you create enough bubbles it asks you what you think will happen and you have guess the answer,
- regardless it zooms into the soap reactions occurring and you watch the reaction occur.
- Once you've seen the reaction you get to answer the question again
- Then something happens in the microscopic scenario and you're asked what happens in the macroscopic level
- Once you answer it zooms back out and shows you what happens and you answer again
- This occurs again when you put lotion on your hands and take your vitamins
- The challenge is to win the game by finishing it a certain amount of time, when you have wrong answers there's a penalty of XX seconds before you can try again
- Interactive part is that you actually have to put soap on your hands and lather
- The lotion you can look at your hands
- The vitamins could be water soluble so you could physically put them in a glass on the sink
- You would have to create the bubbles in your hands for a certain period of time and then be zoomed in
- In the microscopic level you could guess how long the difference is between the lathering and the actual interactions
- You could start by being size in meters as a human and then scaled down to whatever units so that your relatively the same size as the molecules
- Could rank which reaction takes place faster based on putting something in water or in your mouth
- The time you get is based on how well you scored, if you fail you are "Late" if you pass you are able to sprint to class in time

Idea 2:

- Try to create the correct compound to stop a deadly explosion from occurring and save the world
- No time restraint it just has to occur
- More applied to games and action and adventure atmosphere
- Can mix certain chemicals and have obvious reactions seen at the macroscopic level and then go into the microscopic level and see the reactions taking place
- Can rank the size of molecules in the reaction
- Can have the time for the reaction to occur on the microscopic level vs when you see the reaction occur on the macro level

Idea 3:

- You wake up and check your phone and it says Mom "Dad and I are on our way, be home in 30 mins"
- Could make the spills from an "epic' party you had the night before or you're just a messy person and your parents have been away for several days and you waited until the last second to decide to clean
- You have made a mess and there's 30 mins until your parents are supposed to be home
- Need to clean various materials, ie a stain on the carpet, a mark from a drink on the coffee table
- Each time you are told what material is given in the cleaner and elements that will be in the stain and you have to pick which reaction will occur and what will happen physically
- Then it prompts you to ask if its really clean so you have to pick up your dads reading glasses or magnifying glass off the table and then it zooms in closer to the microscopic level, several reactions will occur and you have to guess if the stain was cleaned or then you get zoomed out to check,
- If you were wrong you go back to the microscopic level and have to try again with a different chemical
- Time is a factor because you only have a set duration until your parents come back
- How long you need to let the cleaning formula "soak" before the reactions have taken place could do this from a macroscopic and microscopic level
- Could compare the size of the stain and the size of the molecules of the stain and the size of the cleaning product that comes out in one spray to the size of the molecules to the stain molecules
- Could even include having to put dirty clothes in the washing machine and zoom into the laundry machine and see how long it takes for the reactions to clean the clothes