**Math Simulation**

**Introduction**

The main rationale of the simulation is to let the learners experience ‘reality’ through the procedural representations of experience. The simulation has been designed to introduce the concept of Profit and Loss to the learners. This topic is important because it forms the backbone of several subjects such as Commercial Math, Economics, Finance, and Accountancy. It is relevant not just for academic purposes, but also has practical applications when dealing with monetary transactions. Simulation is considered to be a better medium to teach this concept due to several reasons such as:

- Learners can understand the interplay of different variables involved as they can manipulate one to see its effect on the other in real-time.

- The learning experience will be more situated and context-driven instead of being inert as they will have opportunities to solve advanced real-world problems.

- Usually Math is considered to be difficult for a lot of students, so introducing them to a new topic in this experiential way can avoid them feeling overwhelmed by the content.

**Background**

· **Target Audience**

The simulation has been designed for the Grade – 6 students since the concept of Profit and Loss is usually introduced to them at that level of formal education. It will approximately take 15- 20 minutes for the learners to go through the lesson plan. Learners will be expected to have a thorough understanding of basic arithmetic operations such as addition, subtraction, multiplication, division. Learners will also need to be familiar with the process of calculating percentages for solving the advanced levels of this simulation.

· **Learning Objectives**

1. The student will understand the introductory conceptual framework of Profit & Loss.

2. The student will be able to relate the concept to comprehend real-world situations where the knowledge can be applied.

3. Students will be able to understand the impact of input variables (selling price and cost price) on the output variables (profit and loss).

Connection with **Bloom’s Taxonomy**:-

-Knowledge

-Comprehension

-Application

-Analysis

By the end of the simulation, learners will be able to appropriately explain the concept of profit and loss as well as apply the knowledge to comprehend word problems (textual) and real-world scenarios (contextual).

· **Description of Content**

The following conceptual map guides the design of the simulation:-

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The simulation can be considered to teach the concept at a Beginner’s level and its scope is pertaining to providing the conceptual understanding of the topic under consideration. In the next levels of the simulation, learners get an opportunity to manipulate the input variables and the corresponding change in the output variables will be shown through graphs.

· **Market Analysis**

Although the online resource ‘AdaptedMind Math’ (<http://www.adaptedmind.com/Math-Worksheets.html>) was quite helpful to visualize the design of the current simulation as it has topics graded in terms of difficulty levels depending on the population for which it is designed, yet it does not focus on the introductory concepts of Profit and Loss, instead requires them to solve questions using the formulae.

**Design**

· **Overall simulation idea**

As the students complete the introductory concept level, the simulation proceeds to the next stage where learners will be able to manipulate the input variables (Selling Price and Cost Price) by using the sliders placed beneath them to see its impact on the output variables (Profit and Loss) that are represented graphically. This real-time interaction with the interface and the variables will help learners to make connections with the introductory phase of the simulation where they were exposed to the mathematical relationships between these variables.

· **Platform**

The simulation will require the learners to work with a PC and a mouse. Since the simulation is self-paced, learners will have to click with the mouse to move ahead or go back to any of the sections. It also requires the use of speakers because in the examples section, the sound played for picking up a particular option (profit/loss/none) will vary depending on the accuracy of the response. It will serve as a hint to the learner for reflecting on the response chosen for that question.

· **Visual Design & User Interaction**

The simulation will have a 2D visual design and the user interaction will include the transition from one section to the next through represented through different icons such as Start buttons and arrow buttons.

· **Description of player experience**

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**Theoretical Foundation of Game Design**

Simulation is considered to be a procedural representation of certain aspects of reality (Salen and Zimmerman, 2004). The aim behind learning through simulation is that it helps the learners to engage in deep learning through meaningful play. The Cognitive Load Theory of Multimedia Learning (Mayer, 1947) guides the design of simulations because it helps in arranging the elements (text/graphics) in a way that does not increase the extraneous processing for the novice learners. Instead, the aim is to increase the generative processing so that the prior knowledge can be activated and the new schemas can be connected and integrated with them.

The Multimedia Principles such as Coherence, Split-Attention (Spatial Contiguity) and Segmenting play an important role while designing the simulation frames. The image of profit and loss along with money helps in building an advance organizer for the learners that the concept of profit and loss is related to the monetary transactions. It will also activate their prior schemas about money. Furthermore, the feedback is given to learners which helps them to reflect on their understanding of the concepts. Finally, the self-paced nature of simulation gives them the flexibility to feel the control over learning environment which is needed to reduce the learner’s anxiety.

Apart from the cognitive dimensions associated with the game design, certain other factors that explain the foundation of the simulation are that through the trial-and-error strategy (derives from the behaviorist theory of learning) for problem-solving, the learners feel more immersed in the gameplay as they enter the Magic Circle which keeps them connected till they get the right answer. Since the example is more contextualized, it helps the learners to resolve the conflict and take the right decision as carefully as possible. The model of game design which focuses on the challenge, response and feedback are the building blocks for the design of this simulation. The examples represent the challenge presented to the learners and the sound produced after clicking represents the feedback for the response given by the learners. This motivates the learner to be careful about the accuracy of their responses. These meaningful experiences will help in cognitive, affective, social and behavioral engagement with the game.

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