EDUCATION TOOLS & GAMES

IE3100M SYSTEM DESIGN PROJECT AY18/19 GROUP 21

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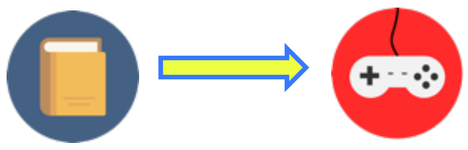
PROJECT OVERVIEW

❑ PROBLEM DESCRIPTION

Decline in effectiveness of traditional education methods in improving learnings of the Gen Z students. This project aims to improve **learning experience** of industrial and system engineering students by gamifying tertiary level educational theories.



❑ Objectives

- ★ Improving learning retention and experience of Industrial and System Engineering students
- ★ Productizing educational games for potential future business purpose
- ★ Improve engagement of students from traditional teaching methods

❑ Key skill sets

- Programming skills (C#) to code the backend script and frontend UI for the games on Unity engine
- Knowledge of ISE concepts: Decision making analysis, Operation Research, Supply chain management
- Simulation - Model building and analysis
- Solution evaluation - User Testing & Feedback analysis

METHODOLOGY

IMPLEMENTATION

★ LEMONADE STAND GAME

❑ **Game Objective**: Maximize profits with decision making skills

Basic | **Intermediate** | **Hard**

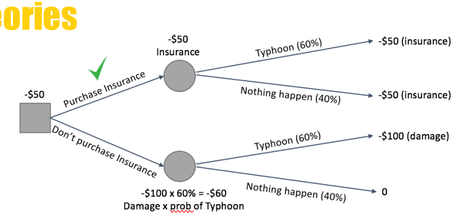
Day 1-2
Figuring out game mechanics:
- ❖ Optimum recipe
- ❖ How to interpret effects of weather and temperature
- ❖ Understanding the performance reports (revenue, costs, profit etc).

Day 3-4
- ❖ Ad-hoc events to vary demand **or** supply
- ❖ Simple decision tree analysis

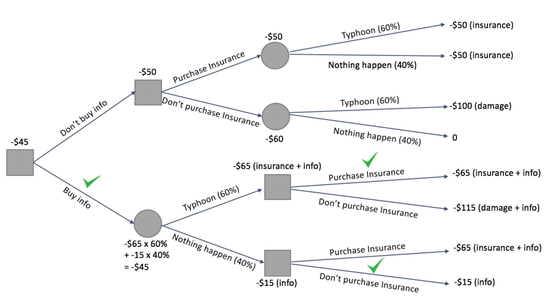
Day 5-7
- ❖ More complex ad-hoc events to test decision making skills
- ❖ Decision tree with option of information purchase

❑ Educational Theories

Decision tree (simple)



Decision tree (with information

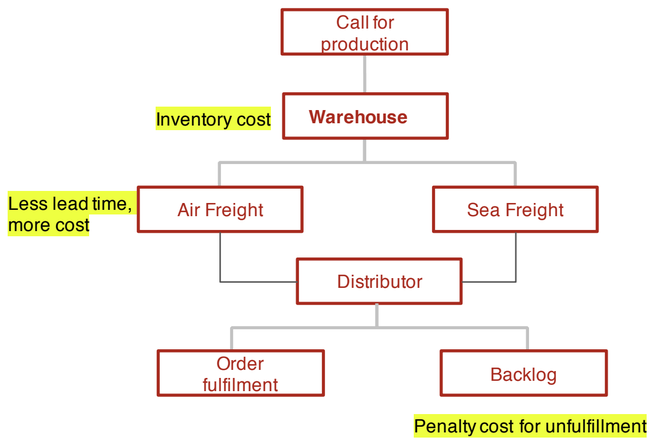


MCDA

	rental	crowd	operating	capacity	Normalized
	0.10	0.43	0.21	0.27	
Cemetery	0.30	0.09	0.14	0.12	0.13
Rice Field	0.24	0.09	0.25	0.15	0.15
Hospital	0.20	0.18	0.25	0.18	0.20
Park	0.13	0.27	0.21	0.31	0.25
School	0.12	0.36	0.16	0.24	0.26

★ SUPPLY CHAIN MANAGEMENT GAME

❑ **Game Objective**: Minimize total expenses with inventory management, demand forecasting and transport logistics planning



Inventory management: Ensure adequate production level to meet the seasonal demand while minimising overproduction to reduce inventory cost.

❑ Educational Theories

Demand Forecasting:

Moving Average Forecast

$$F_t = (1/N)\sum_{i=t-N} D_i$$

Exponential Smoothing

$$F_t = \alpha D_{t-1} + (1-\alpha)F_{t-1}$$

where $0 < \alpha < 1$ and generally is small for stability of forecasts (around .1 to .2)

Holt's Method

$$F_t = S_t + G_t$$

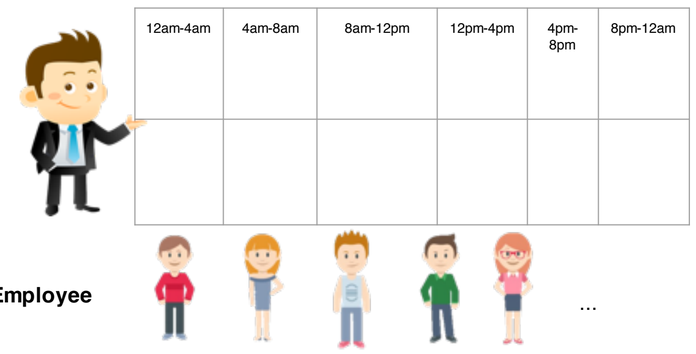
$$S_t = \propto D_{t-1} + (1-\alpha)(F_{t-1})$$
$$= \propto D_{t-1} + (1-\alpha)(S_{t-1} + G_{t-1})$$

$$G_t = \beta(S_t - S_{t-1}) + (1-\beta)G_{t-1}$$

$$F_{\tau,t} = S_t + \tau G_t$$

★ JOB SCHEDULING GAME

❑ **Game Objective**: Minimize total labor used while fulfilling requirements of the operations of the manufacturing firm



❑ Game Design

- ❖ A dynamic and interactive format to present a tutorial question for OR scheduling problem.
- ❖ Explore different combinations of allocation to find most cost efficient feasible solution when facing constraints

❑ Educational Theories

Linear Programming (LP)
- ❖ Player objective function in game is to minimise the total labor used.
- ❖ Constraints on number of workers required in every shift.
- ❖ Labour constraints (availability of individual staff)

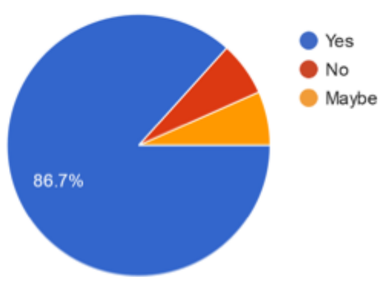
The following are the three theories through gamification:

-Decision making/analysis: MCDA and making a decision tree

-Supply chain management: Demand and cost analysis with forecasting

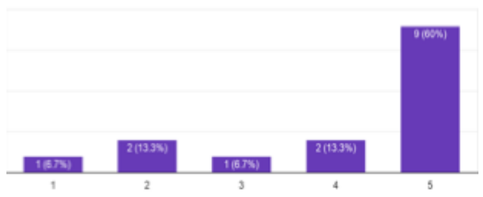
-Operation Research (Scheduling): Linear Programming to optimise scheduling efficiency

USER FEEDBACKS



Q: Would you like to see such games take over lecture contents in the future?

Over 80% of the players from user testing feels strongly about gamification of lecture materials.



60% of the users feel that they have a better understand of how to make a decision tree through the process of the game.

❑ Conclusion

In general, many users enjoyed the interactive and visually appealing gameplay.

FUTURE CONSIDERATIONS

- ★ Explore other domains of ISE knowledge (etc. Little's Law)
- ★ Multiplayer options/ leader's board to incite healthy competition
- ★ Development plan
  - ○ Improvements from larger user database feedbacks
  - ○ In-house testing in the ISE department
  - ○ Possible overseas expansion, leveraging on successful track records

Online subscription-based open platform

Customize for corporate trainings