# ARTIFICIAL INTELLIGENCE TO IMPROVE EXECUTIVE FUNCTIONING SKILLS OF STUDENTS

CHAN MENGMONICHESDA, LE XUAN TUNG, ABEL TAM CHENG YEE
COMMONWEALTH SECONDARY SCHOOL
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## INTRODUCTION

Singapore is known for its robust curriculum and the outstanding academic results. Students are often under pressure due to the heavy demands of the education system. It is found that 90% of secondary school students **reported stressful experiences** related to their **academic work** (Tan, 2022). Students from Grades 9 to 12 **may not respond to general teaching methods and may have poor time management**. Executive Functioning involves the metacognitive process of making decisions, planning actions, and generating responses that are adaptive to environmental demands (Reynolds et. al, 2008). Roberta, 2019 states that the **development of executive functioning skill**s (EFS) is **essential for students to navigate through academic challenges effectively**. Among these skills, planning stands out as a cornerstone, enabling students to organise their thoughts, set goals, and execute tasks efficiently .

## PROBLEM STATEMENT

This project aims to use Artificial Intelligence to help Secondary School students **manage their time better** to mitigate stresses in managing their school work and to **develop their Executive Functioning Skills (EFS)**.

## METHODOLOGY

The following ***indicators*** are the main measures to be ***associated*** for decision making in the application.

- Academic Performance (Grades, Subject proficiency)
- Time management (Break Time Requirements, Activity Time for each activity)
- Competency of EFS

### 1 Setting up training data

### 2 Input of initial training data

**Multiple modes of collection of data to determine the learning patterns and the EFS level of at least 500 students as the initial library for training data.**

***(a) Qualitative Data Collection***

**Use of *Multi-layer perceptron (MLP)* and *Large Language Model (LLM)* to pick out keywords to make associations with the indicators to make decisions in the application.**

- **Explain your daily routines.**
- **What are some of your stresses when doing homework or revision?**

***(b) Quantitative Data Collection***

**The use of Likert scale/categorical questions for association using the models.**

- **Do you prioritise the more important work first?**
- **How often do you hand in your assignments late?**
- **How often do you make a plan for the day?**
- **How often can you follow through the plan?**

***(c) Users' Information***

**Users are allowed to take pictures of the different activities for the application decision making.**

- **Subjects taken, School Dismissal Time**
- **Other programmes, schedule and timetable**

### 3 Association of training data

- Apply ***clustering algorithms*** like ***K-means*** to ***group similar tasks together***, which can help in scheduling similar tasks consecutively for better focus and efficiency.
- ***Classify the difficulties of each homework*** by using ***MLP*** for complex relationships and larger datasets.
- ***Estimate the time taken*** using ***Random Forest Regression*** because of its high accuracy in prediction with multi-variate data.
- Thus, use ***graph neural networks*** to ***generate advice*** relating on the progress for the user.

**Data Collection repeats to improve on the reliability of the output, to better meet user's needs.**

### 4 Generation of timetable

- Divide the free time into sessions by following 'Pomodoro' method by ***generating time intervals.***
- Use ***Dijkstra's or Bellman-Ford algorithms*** to ***find the shortest path*** (optimal sequence of tasks) based on criteria like deadlines, difficulty, and priority (***can be imported in Python using library NetworkX***)
- A ***nested list (numpy)*** is created to ***store the complete timetable*** from the process and will be printed out using ***pandas***.

### 5 Improving on Reliability of Output

- ***Data collection before/during/after the study sessions can be collected.***
- Open-ended questions and closed-ended likert scale questions per day generated randomly to get ***insights on the reliability of output.***
- ***Phone sensors*** (glycometer, microphone, etc) device that detects learning patterns (similar to applications that detect sleeping patterns)

### 6 Determining Level of Competency in EFS

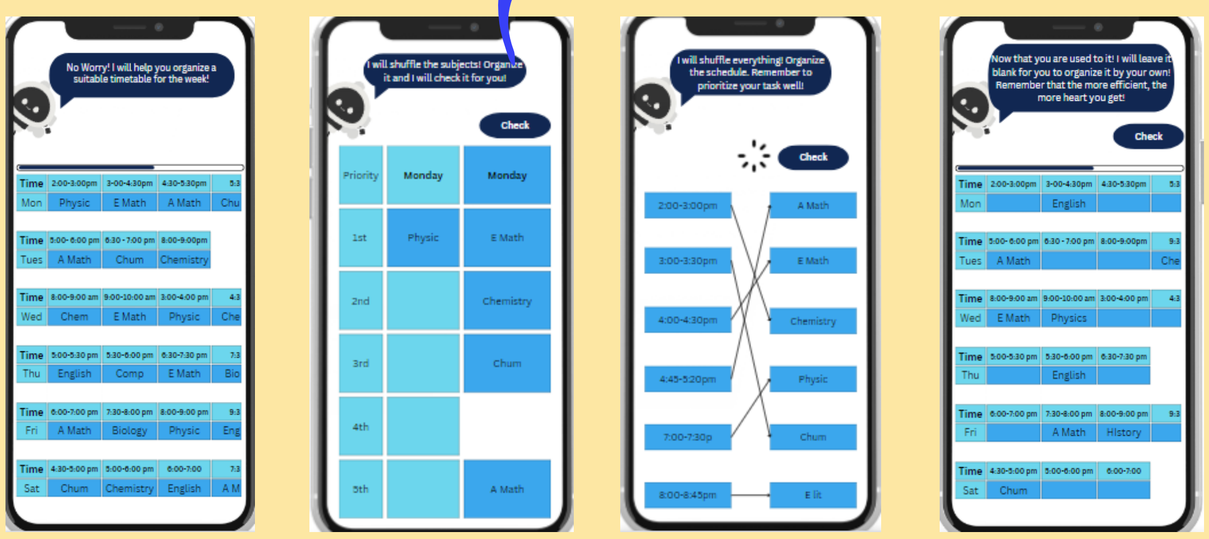
- Test for user to create an ***optimal timetable*** based the sample data will be used, where it compares with generated schedule.
- ***Sensors*** (in point 5) can also be used to determine the competencies (see visualisations).
- ***Chatbot*** can help to ***clarify the questions*** of the students while learning.

## FEATURES OF APPLICATION

- **INTERACTIVE CHATBOT**
  Provision of guidance for users by providing feedback and instructions in a friendly manner.
- **REGULAR ADJUSTMENT OF APPROACHES THROUGH QUESTIONNAIRES**
  Questionnaires given each day related to their personal information including heir planning and learning at school. They will then be categorized into the Competency Levels. (see Visualisations)
- **CUSTOMISED TIMETABLE ACCORDING TO NEEDS**
  The timetable will include a timeline of learning and the various subjects. AI will assist students in creating personalized timetables according to their competency level. Through chatbot feedback, students learn how to organize their own timetable optimally with less help from AI over time.
- **ALLOW FOR BREAKTIME AND OTHER ACTIVITIES**
  Users are allowed to take photos for details of activities and customised an appropiate break time for each learning session ('pomodoro' method) to optimize the students' concentration.

## VISUALISATIONS

Interactive Chatbot to guide user to plan out their timetable.




| Beginner | Emerging | Intermediate | Competent |
|---|---|---|---|
| ★ | ★★ | ★★★ | ★★★★ |
| Timetable is generated based on information given to the application. | Users will be guided to organise their timetable. | Users are to prioritize their tasks by matching time with subjects | Users will be given empty table. They will organize the time table themselves. The app will help check the organizational skill of the user. |

## LIMITATIONS

1. **Reliability of Self-Reported Data**: Self-reported data is subject to bias and dishonesty. It could lead to incorrect categorization and personalized recommendations.
2. **Subjectivity in Difficulty Assessment**: Users have different perceptions of difficulty of tasks leading to inconsistencies in prioritization and scheduling.
3. **Privacy and Data Security**: Some users' data are sensitive in nature, including users' learning habits and progress tracking, it might compromise their privacy and safety if the data is leaked and misused.
4. **Different Needs of Students**: Students have diverse learning styles and schedules, making it difficult to create a one-size-fits-all timetable.
5. **Reliability of training data:** Outdated or biased data can lead to ineffective timetables. Bias in data can lead to AI system making unfair or discriminatory decisions (Arman, et. al, 2023).

## REFERENCES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