

# Implementation of a Chatbot in an Online Chemistry Course: Usage Analytics

## Theme: Innovative Technologies

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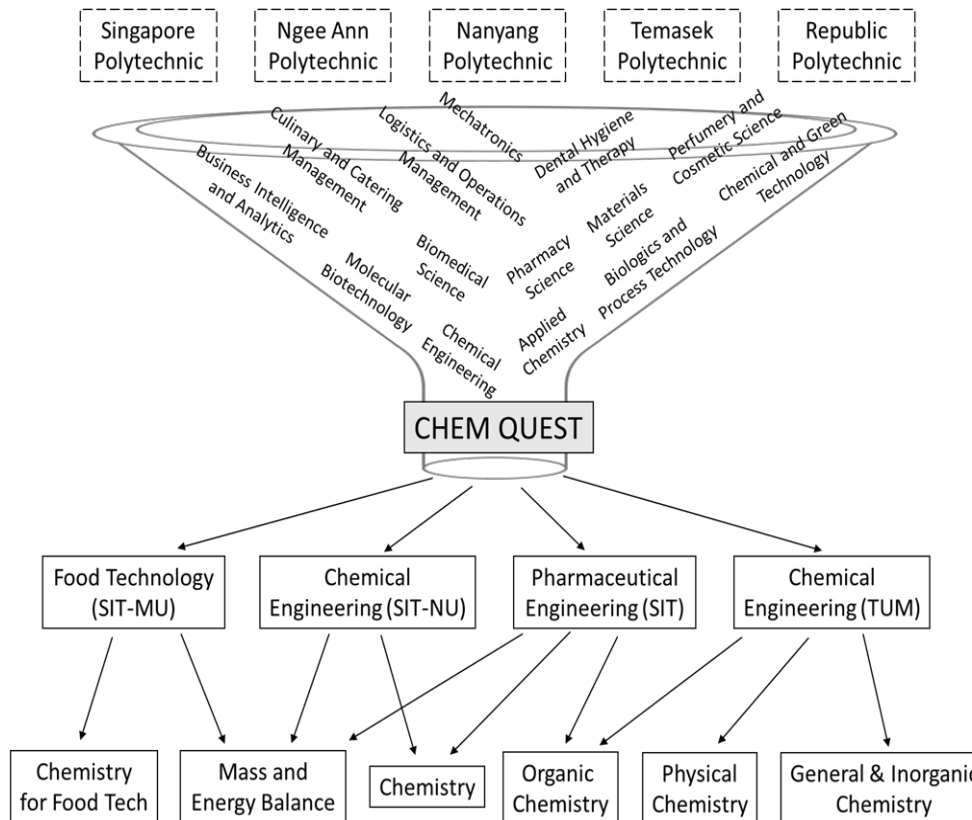
FUTURE WORKS



# Background

# Background

Chemistry Quest (Chem Quest) is a fully online learning platform designed to ensure matriculated students from different backgrounds start their university studies on equal footing.



# Background

- Voluntary, non-credit bearing
- No online instructor
- Own time, own pace
- Learning materials followed by tutorial questions

3.0

You have scored 1 out of 1.

1. A student was asked to calculate the density of Chemical A with the given mass and volume of Chemical A as 28.367 g and 3.74 cm<sup>3</sup>, respectively.  
Calculate the density of Chemical A to the appropriate number of significant figures.

- ☐ 0.132 g/cm<sup>3</sup>  
☒ 7.58 g/cm<sup>3</sup>  
☐ 24.63 g/cm<sup>3</sup>  
☐ 106 g/cm<sup>3</sup>

✓ Yes, that's correct!

### Solution

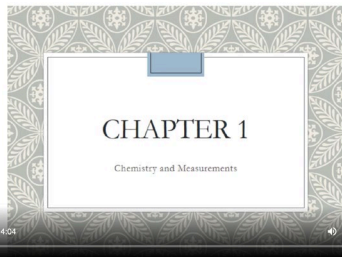
$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{28.367\text{g}}{3.74\text{cm}^3} = 7.5848\text{g/cm}^3 \approx 7.58\text{g/cm}^3$$

In division, the final answer is rounded off to the same number of significant figures as the measurements with the least significant figure.

(Master) Chem Quest 2021

## Introduction

Watch this video for an overview:



(Master) Chem Quest 2021

This Activity contains 2 Learning Goals

## 3. Rules of Multiplication and Division

If you need help, please go through the following learning resource(s) before you attempt the questions:

### Significant figures

[Addition/Subtraction Rule \(Tyler\)](#)  
[Multiplication/Division rule \(Tyler\)](#)

### Units conversion factors

[Multiple Conversion Factors \(Tyler\)](#)

### Density and Specific Gravity

[Specific Gravity \(Khan Academy\)](#)  
[Density \(Cleanairfilms\)](#)

### Moles to mass to number of molecules conversion

[Conversion \(TheChemistrySolution\)](#)

(Master) Chem Quest 2021

You are seeing this because you appear to need help with '3.0'

## Hints for 3.0

Consider the following before reattempting the question:

- The formula of density is Mass divided by Volume and not Volume divided by Mass.
- Take note that the unit of density is g/cm<sup>3</sup>
- The units for volume and mass are not the same, therefore they cannot be subtracted from each other.

For more guidance, refer to resources provided at the start of this Section.

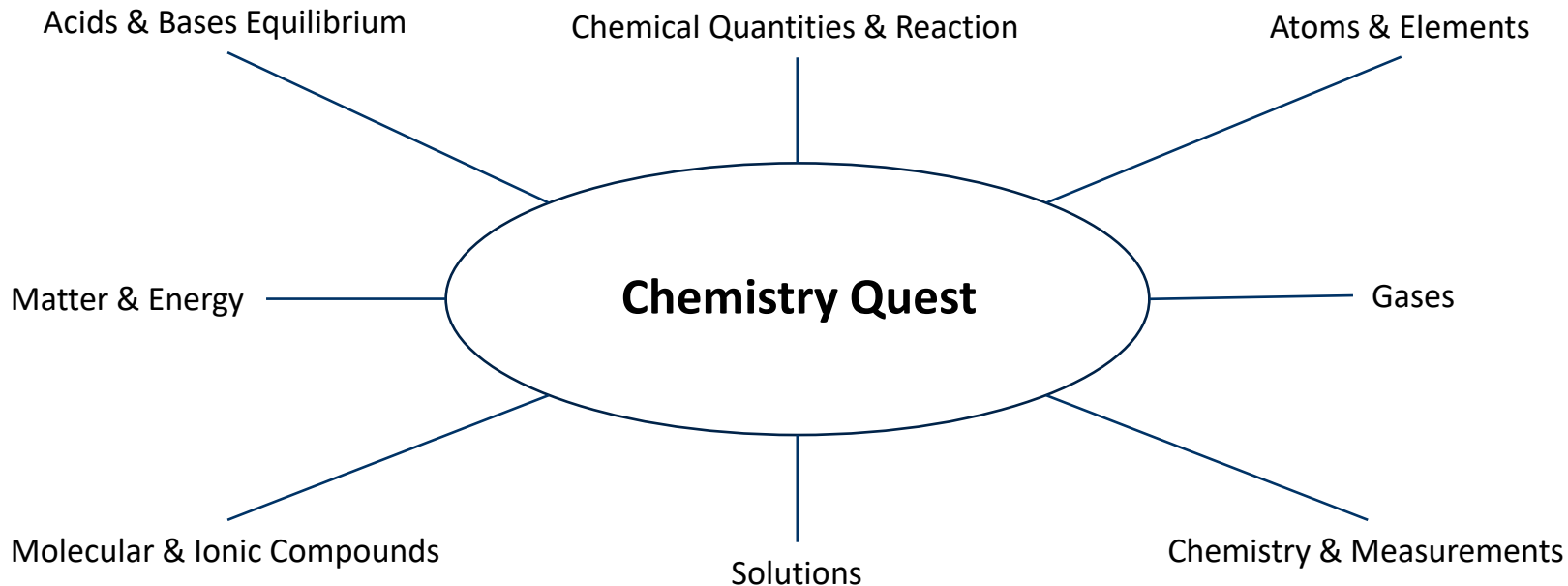
How well did you understand 'Hints for 3.0'?

Drag Me

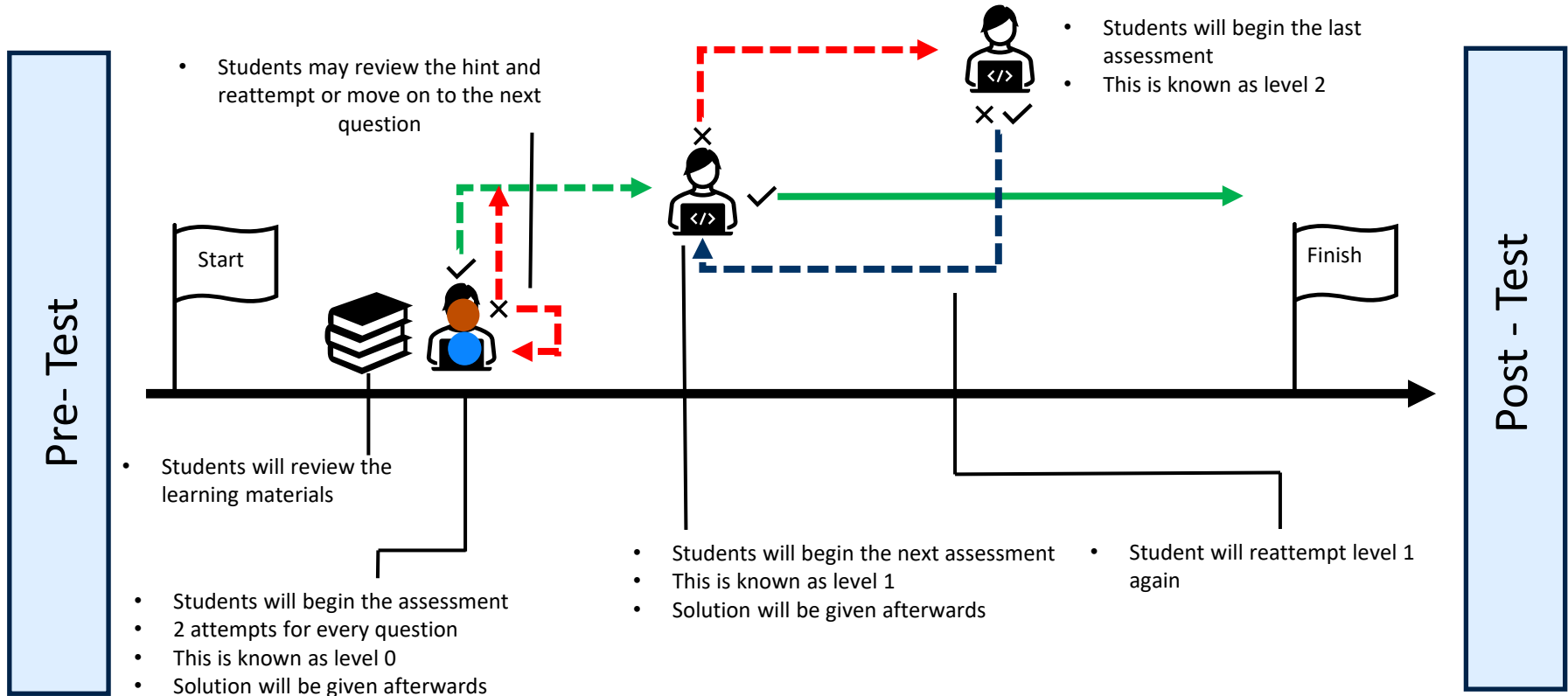
< I didn't understand it

I completely understood it >

# Background



# Background



# Background



79% agreed that Chem Quest enhanced their chemistry understanding



But only  $< 15\%$  of students who start will finish

Some reasons cited include students feeling lost when they have doubts or questions to ask due to the lack of instructor

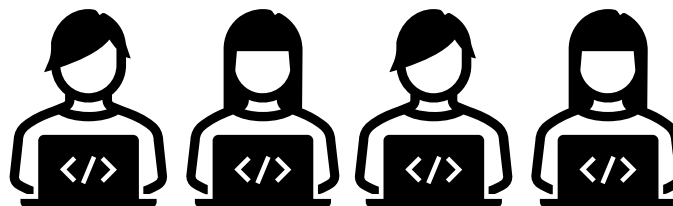
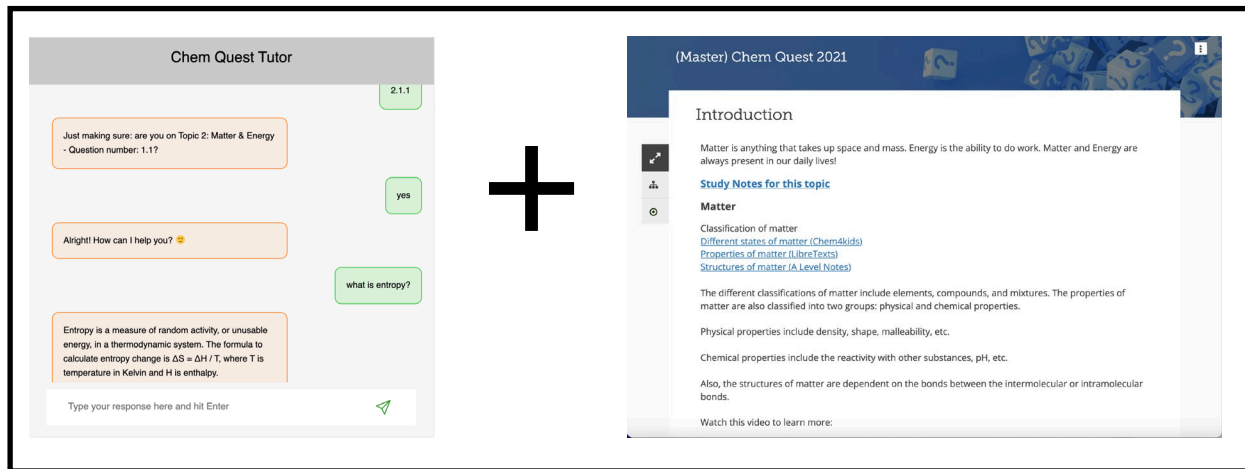




# Introduction

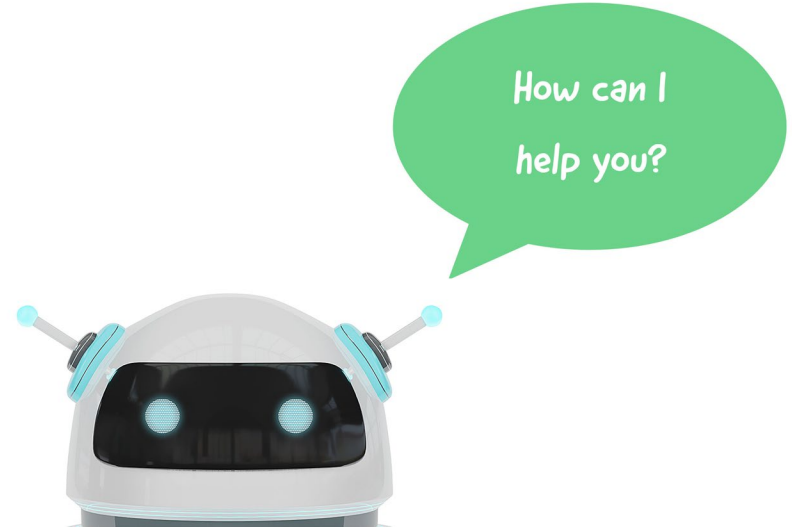
# Introduction

In this study, a chatbot was implemented in Chem Quest (CQ) for matriculated students in the Chemical Engineering and Food Technology (CEFT) cluster in Singapore Institute of Technology



# Introduction

- Chatbots are software that allows interactions through text messages
- Chatbot have also been used to determine students' struggles during their university journey\*
- Chatbot also have been function as a tutor even though it is rare

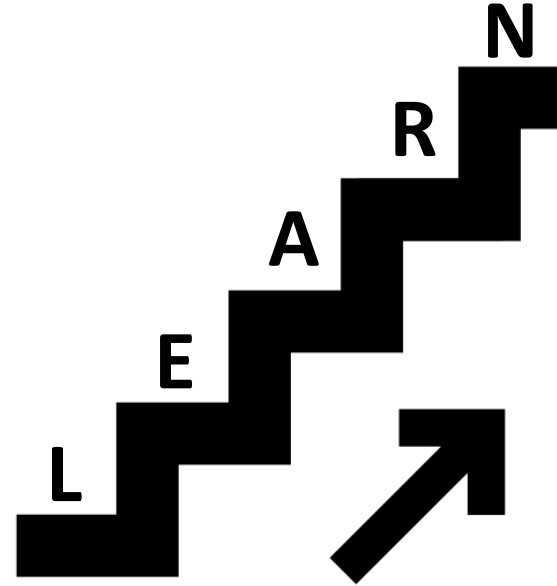


\*<https://www.forbes.com/sites/michaeltietzel/2020/03/12/how-colleges-can-chatbot-their-way-to-better-student-retention/?sh=25bd7f176b34>

# Introduction

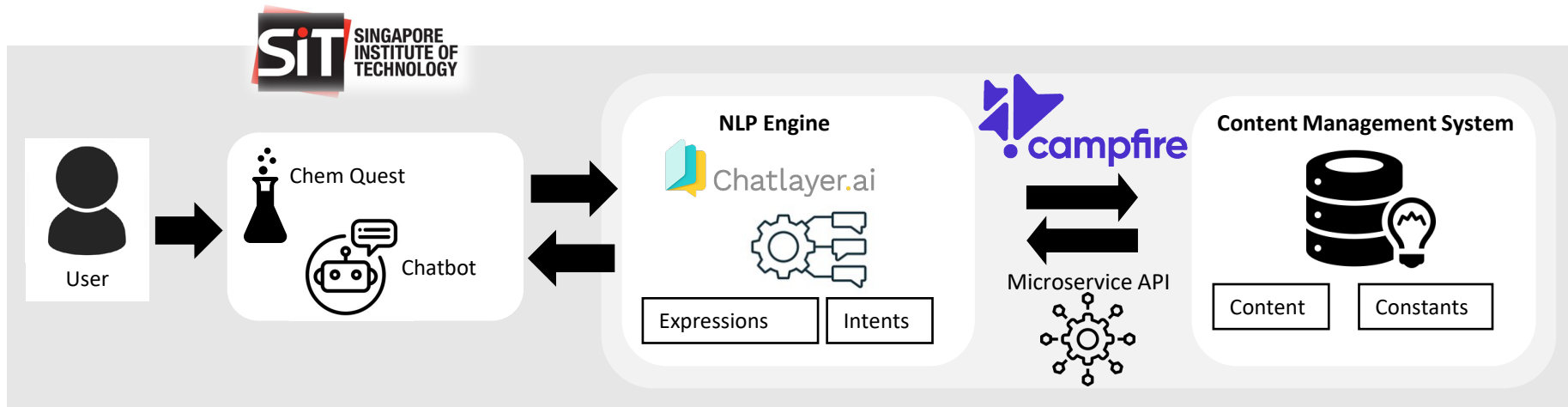
The chatbot is designed to fulfil the following requirements:

- Provide answers to content-related questions
- Scaffolding the learning for the students
- Providing on-demand synchronous communication and support



# Methods

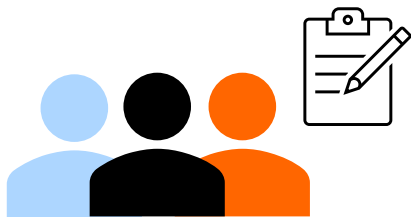
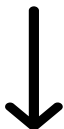
# Methods



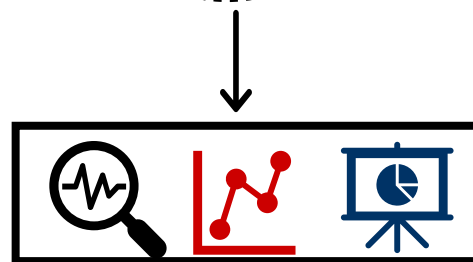
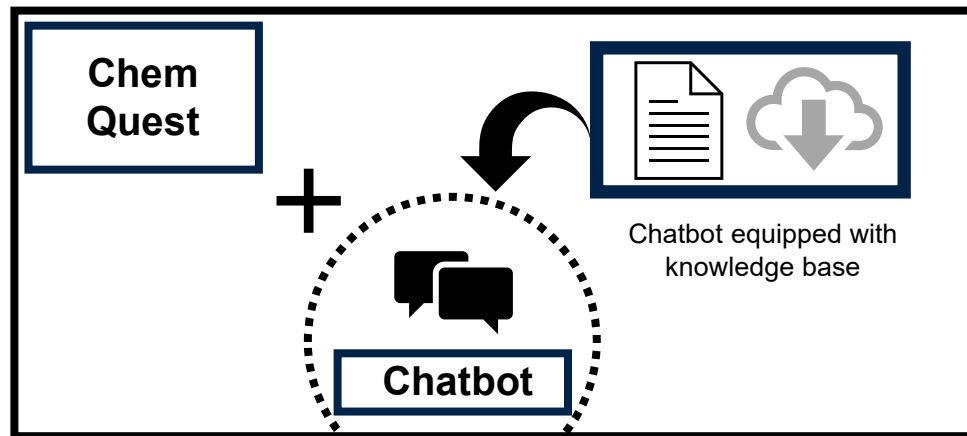
- The chatbot was developed with Campfire AI using the Chatlayer platform
- Campfire: Designs conversations, provides microservice API
- Chatlayer: Deep learning platform that can interpret and answer question intelligently based on contextual information using natural language processing (NLP) algorithms

# Methods

CEFT students were offered the chatbot along  
with Chem Quest in **July 2021 to August  
2021**



Some of the students are recruited to  
participate in the studies



The chatbot usage was analyzed

# Methods

Chem Quest Tutor

Alright! How can I help you? 😊

I need some hints... how do I start?

Reverse osmosis is an energy demanding process due to the constant pressure applied to the sample of water (sign of  $\Delta G$ ). 😊

Hope that helps!

Do you still need help?

I still don't understand

Chem Quest Tutor

I still don't understand

Use equation " $\Delta G = \Delta H - T \Delta S$ " to determine the sign of  $\Delta S$  ( $\Delta H$  is considered to be zero)

Hope that helps!

Can I help you with any other doubts on the question from Chem Quest?

yes

Is this question also about Topic 2: Matter & Energy - Question number: 5.2 ?

Chem Quest Tutor

Is this question also about Topic 2: Matter & Energy - Question number: 5.2 ?

yes

Ok, what is your question?

do you have a video?

Entropy: Embrace the Chaos! Crash Cou...  
Watch later Share  
Sec 20-0  
**ENTROPY**  
Watch on YouTube

thank you!

Anytime!

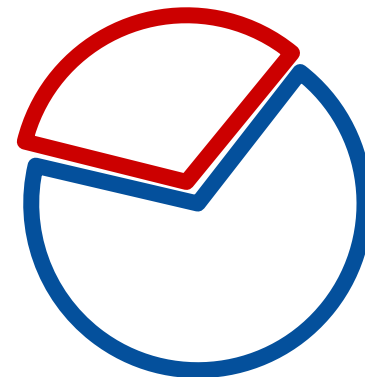


# Results

# Results

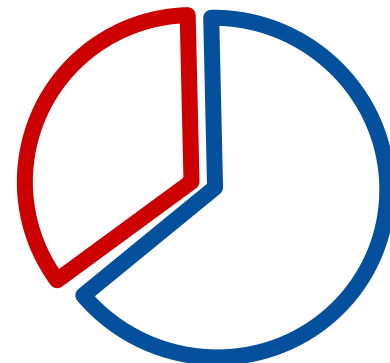
Among the students that  
were offered Chem Quest

**33%**  
Completed the  
Chem Quest course



Among the students that  
completed Chem Quest

**38%**  
Interacted with the  
chatbot



# Results

123

Conversations

of the student-  
chatbot interaction  
were recorded

979

Messages

were sent by the  
students to the  
chatbot

8

Messages

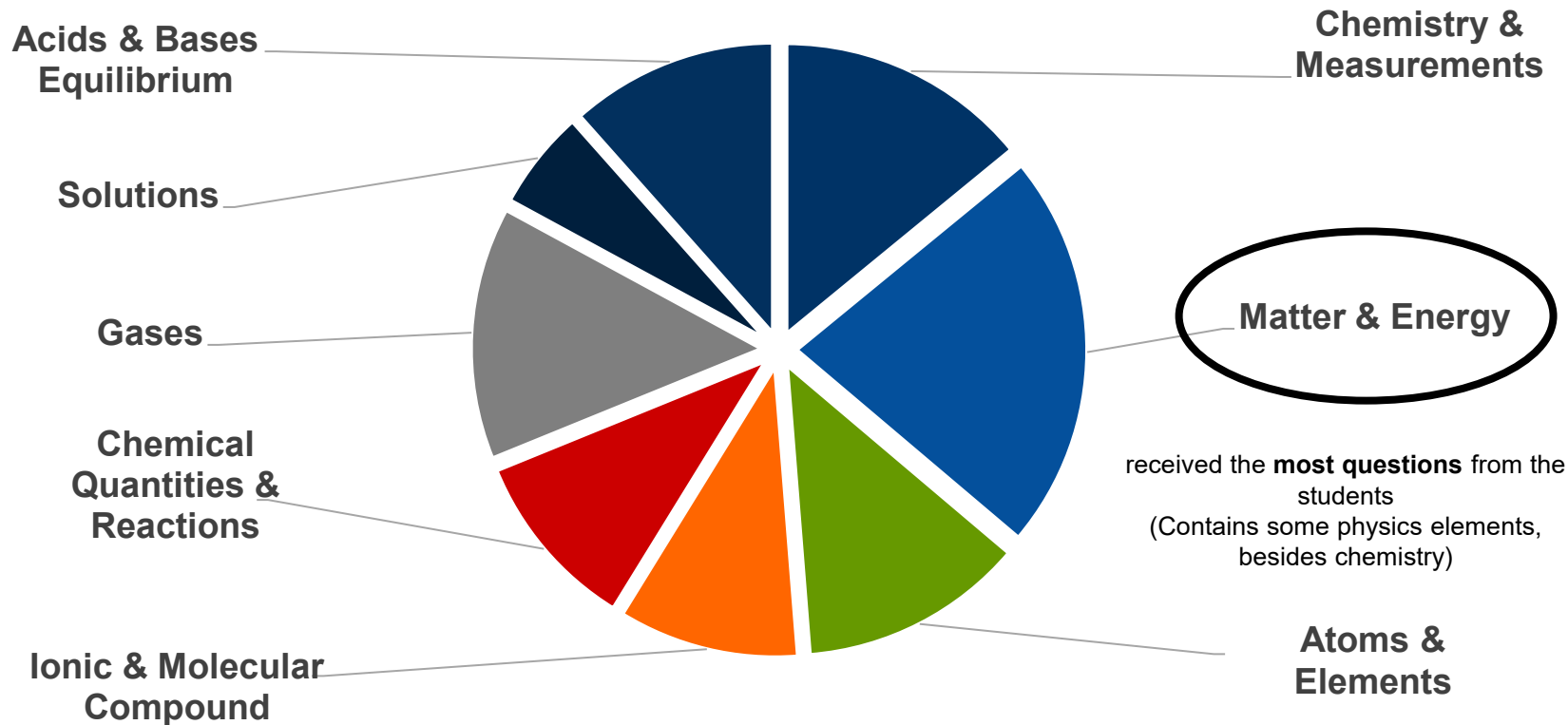
was the average  
messages per  
conversation

5.3

Minutes

was the average  
conversation  
duration per  
conversation

# Results

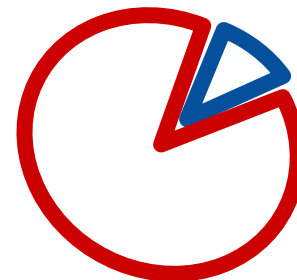


# Results

**High volume of messages  
were sent**

**90%**

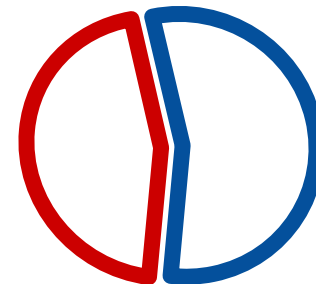
**Of the messages were  
correctly understood  
by the chatbot**



**Messages were sent  
throughout the day**

**53%**

**Of the messages were  
sent outside office  
hours (9am to 5pm)**



**The students were asked  
to rate the support given  
by the chatbot**

**3**

**out of 5 natural score  
was given to the  
chatbot**



## Conclusion

# Conclusion

- The usage analytics show students' level of interaction with an available chatbot
- The chatbot was able to answer 53% of the questions asked outside office hours
- The chatbot requires further improvement considering the neutral rating



# **Future Works**



# Future Works

- Complementary qualitative portion of this research project will be analysed
- Aim to develop a chatbot competent in supporting students through their online Chemistry course



# Acknowledgement

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Feel free to drop me an email at [hetong.ng@singaporetech.edu.sg](mailto:hetong.ng@singaporetech.edu.sg) should you have any questions or queries regarding our research.

## Questions??

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