



## School of Computing Science

### INF2002: Human Computer Interaction

**2023/2024 Trimester 1**

#### **Final Report**

#### **Submission By:**

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#### **Professor:**

Professor Jeannie Lee

Professor Chen Ming

Professor Kan Chen

## **1. Introduction**

### **1.1 Problem Statement**

Picking up a new programming language is a tedious process. For an experienced programmer, it is akin to learning a new dialect of a language you have knowledge in. However, for someone who has no experience in programming, it may be difficult to grasp many fundamental concepts. This difficulty is further amplified by the variance in learning styles of each and every one of us, as well as the various different teaching methods employed by our professors. Hence, what methods can we employ in order to provide a solution to both experienced and inexperienced programmers in picking up a new language, while also conforming to the standards and teaching outcomes set out by the school?

### **1.2 Focus Area**

We will mostly be focusing on the undergraduates who are currently pursuing IT degrees. As some undergraduates may come from IT-related diplomas, while some might not, it is important that our solution can cater to the various learning styles from our various demographics.

### **1.3 Activity or Situation**

We have decided to employ several needfinding methods in order to better understand the various difficulties that a student/lecturer might encounter. Our purpose is to answer the following:

1. What problems do students generally face when picking up a new programming language?
2. How does having prior knowledge in programming languages affect their ability to pick up a new language?
3. How significant does the variance in teaching style of our professors/lecturers affect the student's ability to pick up a new language?
4. How do we provide a solution which can conform to the university's standards and learning outcomes?
5. What kind of solutions will students take during their journey to learn programming languages?

## **2. Needfinding**

### **2.1 Needfinding Methods**

#### Online Surveys/Questionnaires

Surveys/Questionnaires allow us to capture the opinions of a broader audience, which can enable us to create informative diagrams, graphs and tables. To achieve this, we will be distributing surveys to students within the academic environment, and these surveys will be designed to capture quantitative data and opinions from a larger sample size. Our obtained survey results comprised 27 responses in total.

#### Interviews

Interviews allow us to better empathize with the learning process faced by our students. Specifically, we'll be focusing on students with no prior knowledge of programming for our Interview participants. Our interview will be semi structured, consisting of a scripted question and follow up questions. We will be interviewing a total number of 3 students.

## 2.2 Needfinding Results & Conclusions

### Survey & Questionnaire

Survey Questions	Summary
Do you come from an IT background? [Figure 1.]	<ul style="list-style-type: none"> <li>• 70.4% come from IT backgrounds</li> <li>• 29.6% coming from non-IT backgrounds.</li> </ul>
How many programming languages are you well-versed in? [Figure 2.]	<ul style="list-style-type: none"> <li>• 55.6% know at least 1-3 programming languages.</li> <li>• 25.9% know 4-5 programming languages</li> <li>• 18.5% know none.</li> </ul>
On a scale of 1 to 5, how challenging would you rate your experience when learning a new programming language? [Figure 3.]	<ul style="list-style-type: none"> <li>• 14.8% feel that it is not that challenging,</li> <li>• 37.0% feel that it is challenging,</li> <li>• 25.9% feel that it is quite challenging</li> <li>• 22.2% feel that it is very challenging.</li> </ul>
When you're picking up a new programming language, what are some problems you face? (Select all that apply) [Figure 4.]	<ul style="list-style-type: none"> <li>• 44.4% - Lack of documentation</li> <li>• 70.4% - Difficulty understanding the purpose of built-in functions/methods</li> <li>• 74.1% - Syntax and structure</li> <li>• 77.8% - Advanced Concept</li> <li>• 3.7% - Documentation is difficult to read.</li> </ul>
On a scale of 1 to 5, how would you rate the effectiveness of the current teaching styles employed by your professors in facilitating your learning? [Figure 5.]	<ul style="list-style-type: none"> <li>• 66.7% of the respondents feel that it is neutral in terms of effectiveness.</li> <li>• 7.4% feel its not effective at all</li> <li>• 22.2% feel that it is not effective.</li> <li>• 3.7% feel that it is quite effective</li> </ul>
Which specific teaching style(s) do you find most conducive to your learning? (Select all that apply) [Figure 6.]	<ul style="list-style-type: none"> <li>• 40.7% feel that lecture-based instruction conducive</li> <li>• 96.3% believe that hands-on activities are conducive</li> <li>• 40.7% deemed Visual aids to be conducive.</li> <li>• 29.6% deemed Group discussions and online resources to be conducive</li> <li>• 77.8% feel that online resources and videos are conducive</li> </ul>
Which of these resources do you most frequently use to clarify programming concepts? [Figure 7.]	<ul style="list-style-type: none"> <li>• 44.4% frequently use online tutorial</li> <li>• 14.8% clarify their doubts with lecturers</li> <li>• 7.4% reference sources code online</li> <li>• 3.7% reference official documentation</li> <li>• 22.2% reference online forums for information</li> </ul>
Do you believe your learning style is best described as visual, auditory, kinesthetic? (User may pick multiple option) [Figure 8.]	<ul style="list-style-type: none"> <li>• 74.1% of the participants express a preference for visual learning</li> <li>• 18.5% favor auditory methods,</li> <li>• 77.8% lean towards kinesthetic learning</li> </ul>

How often do you find it challenging to adapt to a professor's teaching style that does not align with your preferred learning style? [Figure 9.]	<p>Most respondents find it pretty challenging to adapt to a professor teaching style as it does not align with their way of learning</p> <ul style="list-style-type: none"> <li>● 18.5 % said frequently</li> <li>● 63% said occasionally</li> <li>● 18.5% said rarely.</li> </ul>
Would you find it helpful to have a centralized resource (e.g., a website, platform, or academic advisor) that provides guidance and resources tailored to your learning style? [Figure 10.]	<ul style="list-style-type: none"> <li>● 96.3% agreed that it will be helpful to have a centralized resource that provides guidance and resources to cater to their teaching style.</li> <li>● 3.7% did not agree to it.</li> </ul>
How likely are you to actively engage with and utilize a centralized resource if it were made available to you? [Figure 11.]	<ul style="list-style-type: none"> <li>● 3.7% feel that they are unlikely to use the resource.</li> <li>● 25.9% feel neutral to it</li> <li>● 22.2% are likely to use it</li> <li>● 48.1% feel that they are very likely to use it.</li> </ul>
Do you have any additional comments or suggestions for improving the learning experience by addressing the diversity of teaching and learning styles? [Figure 12.]	<p>Some responses obtained are:</p> <p>'Maybe the slides should be animated instead of making it in PDF which does not illustrates how the algorithm work very clearly'</p> <p>'Use an algorithm to generate content needed to learn by the student in accordance to their preferred learning style'</p> <p>Provide the language to be learnt before the module begins, so that students will be able to self practice before the module begins.</p> <p>Students should be given more access to materials such as, practice tests, practice scenarios or coding projects where they can test and push their skills further</p>

## Interview

Student/Professor	Question	Summary
Students	1 - Scripted	<ul style="list-style-type: none"> <li>● Programming fundamentals should be taught from scratch, for example, basic to expert.</li> <li>● Tutorial sessions need to be catered longer.</li> <li>● Usage of metaphorical to study.</li> </ul>
	2 - Scripted	<ul style="list-style-type: none"> <li>● Lessons should be more straightforward with key learning points, straightforward and organized.</li> <li>● Online lectures are more in depth.</li> </ul>
	3 - Scripted	<ul style="list-style-type: none"> <li>● Online tutorials on setting up software.</li> <li>● Different notes cater to different learning styles to students.</li> <li>● Kahoot quizzes embedded into applications where answers and explanations can be shown.</li> </ul>

	4 - Scripted	<ul style="list-style-type: none"> <li>Preparation of course mini modules for students to learn that is based on what they will be learning.</li> <li>In-built chat platform for students to ask professor during lecture instead of waiting for break to head down and ask questions.</li> <li>Noise cancelling earphones in case of noisy environment, just to hear the professor.</li> </ul>
	5 - Follow up	<ul style="list-style-type: none"> <li>Different programming language adaptability and school resources are not useful.</li> <li>Some modules' lecture teaching style may be useful for some students but not for other students.</li> </ul>
	6 - Follow up	<ul style="list-style-type: none"> <li>Usage of VR/AR to help learning, online tutorial videos and important notes compilation from powerpoint slides.</li> </ul>
	7 - Follow up	<ul style="list-style-type: none"> <li>Doom Scrolling video section for entertainment and knowledge information.</li> <li>Feedbacks on things to improve on and what mistakes made by students.</li> <li>As students do doom scrolling, they come upon feedback sessions to whether they have learned anything new from the doom scrolling education videos.</li> </ul>
Professor	1 - Scripted	<ul style="list-style-type: none"> <li>Allow the application to be more flexible, modularized and customized with different features and user needs.</li> </ul>
	2- Scripted	<ul style="list-style-type: none"> <li>Do a survey on the comparison between non application product users and those who use it.</li> <li>Do a data analysis on the application to see its impact on the users.</li> </ul>

### 2.3 Task Analysis

Step	Description
0	<b>Pick up new concepts from Lecture</b>
1	<b>Enter the Lecture</b>
(a)	Navigate to xSITE to find zoom link
(b)	Walk into the Lecture Theatre to find a seat
2	<b>Prepare for Lecture</b>
(a)	Navigate to xSITE and find the Lecture Content

<b>(b)</b>	Download lecture documents
<b>(c)</b>	Open up slide/document in a PDF reader (e.g., Edge, Adobe Acrobat, etc.)
<b>3</b>	<b>Listen during Lecture</b>
<b>(a)</b>	Understand the contents of the lecture slide, as well as what the lecturer is saying
<b>(b)</b>	Annotate slides with key information brought up by lecturer
<b>(c)</b>	Note down a list of questions to ask the lecturer
<b>4</b>	<b>Clarify Confusion during break</b>
<b>(a)</b>	Seek clarification from professor
<b>(b)</b>	Discuss material with classmates
<b>(c)</b>	Search online for answers (e.g., ChatGPT, Youtube, Stackoverflow)
<b>(d)</b>	Official communication channels (e.g., xSITE's discussion forum, email)
<b>5</b>	<b>Utilize new concepts via revision</b>
<b>(a)</b>	Tutorial & Lab exercises
<b>(b)</b>	Online resources
<b>Plans</b>	
<b>Plan 0:</b> Do 1, 2, 3, 4 in order. Repeat 3 & 4 until lecture ends	
<b>Plan 1:</b> Do (a) or (b), but not both	
<b>Plan 2:</b> Optional, skip OR do (a), (b), (c) in order	
<b>Plan 3:</b> Do (a) AND [(b) or (c)]	
<b>Plan 4:</b> Optional, skip OR do (a), (b), (c) or (d)	
<b>Plan 5:</b> Optional, skip OR do (a) or (b)	

## 2.3 Identified User Needs

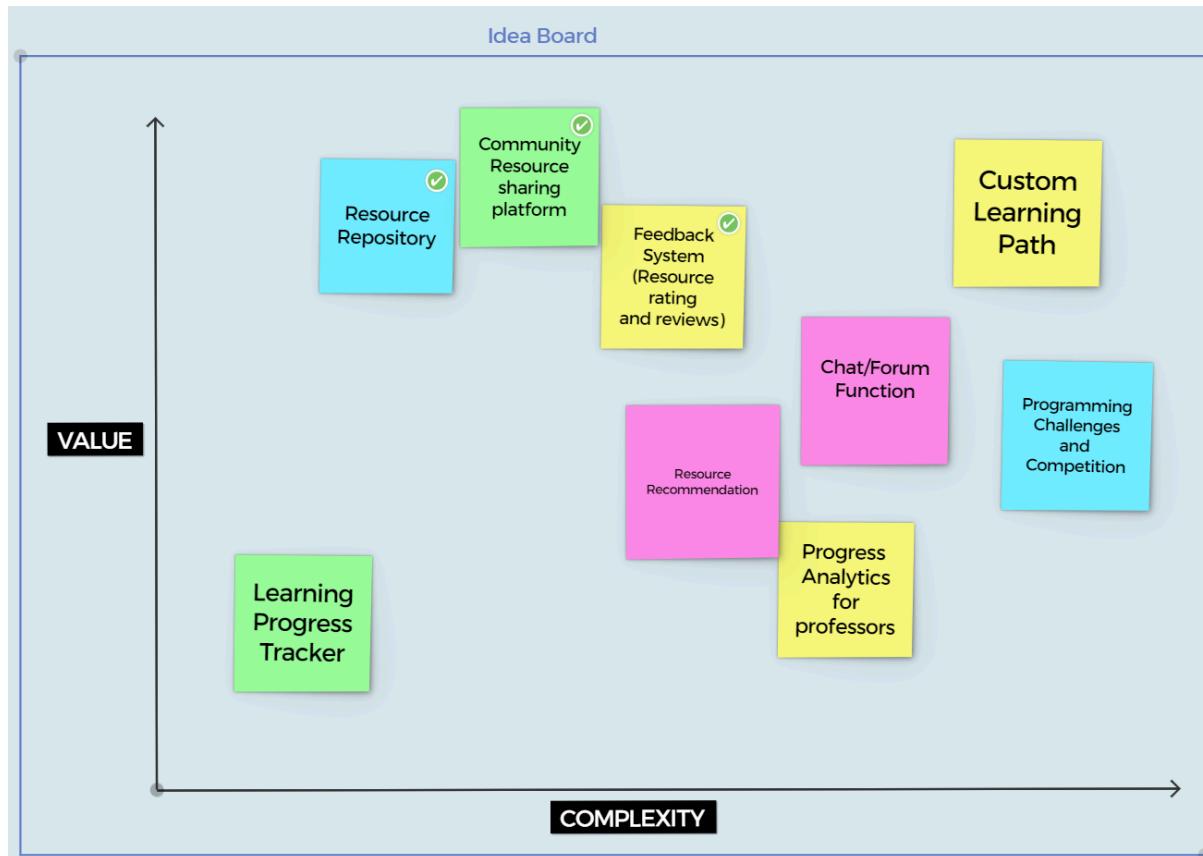
1. Students require online resources on top of lecture content to understand programming concepts better
2. Students require resources that are more hands-on in nature, as most of them are kinesthetic and visual learners
3. Students require resources that are able to cater to various learning methods, as the teaching methods employed by the faculty may not always align with their learning style.
4. Student require documentations of a programming language to be well documented, such that they are able to pick up new programming language with greater ease (as well as understanding the unique concepts of a new language)
5. Professor require a platform which is flexible and modularized in order to cater to various learning styles

## 2.4 Conclusion

Based on the results obtained from both the surveys and interviews, most of the students feel that their learning style is more towards visual and kinesthetic learners, while having more detailed steps and images to elaborate the concept of the topic and programming language. Based on the survey, having a centralized resource, will help them provide guidance and resources that will be tailored to their learning style. On the other hand, for the interview, most of the students prefer to be taught from the basics based on their modules as well as a guide to help them understand what are the important parts to take note of. Most importantly, the modules can be broken down into different stages to provide a linear learning for the students. In addition the students wish for different learning styles catered by the professor to help them understand better. Last but not least, the professor hopes for an

### 3. Storyboards & Prototypes

#### 3.1 Idea Board



#### Design Ideas

1. **Resource Repository :** A platform with a manual/documentation detailing each function/methods, structure and features of each programming language, curated by the school. It can also include tutorials to explain how the function is used, and provide exercises to test student's concepts.  
Similar to <https://www.w3schools.com/>
2. **Custom Learning Path :** Platform with multiple features such as fundamental learning that comes in various learning styles. This feature also include showing video guides, coding practices , best practices for different type of learners.
3. **Learning Progress Tracker :** Have an indicator of how much the student have covered in the particular programming language.
4. **Progress Analytic for professor :** A feature for the professor to view insights on how the students are performing that way it allows the professor to create a more customised lesson plans, incorporating different teaching styles and resources for students with varying preferences.

5. Programming Challenges & Competition : Gamification elements like quizzes and challenges for students to apply knowledge learned and to make learning more engaging and competitive.
6. Community Resource sharing platform : A feature that allows students to share any resources which might be helpful something like a forum.
7. Chat / Forum Function : A feature that contains the different concepts taught by the professor for each lecture. From there, students are able to make clarifications and ask questions using a forum-like section on the specified concept, such that any faculty member can get back to the student (does not have to be the professor teaching that module, any faculty member is allowed to respond)
8. Feedback System (System Resource rating and review) : Have a feature where student are able to rate the source this way the professor is able to better understand student's need.
9. Resource Reccomendation : Serve as a bookmark feature where student's can pick up back where they left off.

### Selected Design Idea: Mobile Learning Platform

#### Key Features:

- Modularised content : Splitting the contents into bite size for easier absorption. Each programming language will be broken down into smaller content and have video explaining each concepts. Videos will be included to serve as a visual representation and will be helpful for the visual learners.
- Documentation Manual : Contains the documentation of various programming languages taught by the institution. The application is tightly integrated and reference from official documentation sources which allows student to explore other concepts that are outside the scope of what's taught by the institution.
- Quizzes & Challenges: Professors can create and share quizzes & challenges to gauge the cohort's aptitude and understanding, which provides a platform for applied learning. Particularly useful for hands on learner and professor to guage the student's understanding.
- Discussion Forum: A forum where students can ask questions and engage in discussions related to their studies. Professors can participate and provide expert guidance.
- Curation:  
The institution and faculty members are able to personally curate the content within the application, in order to align the content provided with the school's standards and learning outcomes. This could involve a selection process where professors create lab challenges , tutorials exercises, and other resources that best fit the curriculum and the students' needs.

## Justification:

- Hands-On Learning : With features like interactive coding exercise and simulations, the mobile app address the need for hands-on learning experience making it easier for kinesthetic and visual learners to grasp complex topics.
- The flexibility of a mobile application allows for the incorporation of various teaching methods and resources. This versatility ensures that students can find content that resonates with their individual learning styles.
- Mobile application provides portability, convenience which allows students to pick up new concepts on-the-go.
- A mobile app also acts as a second display, which facilitates better multitasking when a student wishes to code while referencing a documentation.

## Why Mobile?

- Learnability and Flexibility : Our mobile platform features a user-friendly interface that simplifies navigation and learning for students, which is especially beneficial for cognitive demanding subjects such as programming. Its modular layout accommodates student's diverse cognitive capabilities allowing them to learn at a comfortable pace in manageable segments, essential for mastering the intricacies of programming
- Contextual Learning : Our mobile application offers on-the-go access to learning materials, eliminating the need for bulky laptops. Users can conveniently access content from anywhere. While 'on-the-go' learning was not identified as a need in User 1, the ability to learn in different context is essential aspect of HCI. A mobile platform allows for situation learning where students can utilise spare moments effectively such as during commute which can enhance retention and understanding of concepts through repetition and application in various contexts.

Accessibility and availability :With a mobile application, resources are always within reach regardless of student's physical location. This aligns with modern expectations for immediate access to information and supports a more inclusive approach to education where resources are not bound to a physical classroom or computer.

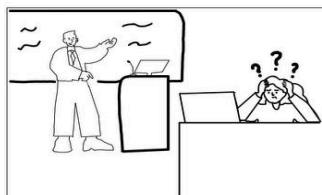
- Furthermore, mobile application can offer a higher level of interactivity through touch interfaces which can lead to greater engagement with the content. Interactive quizzes, coding simulators and other engaging activities can be optimised for mobile use, providing immediate feedback that is essential for learning especially for programming.
- User Feedback: We've taken user feedback into account, focusing on visual elements and additional resources to complement traditional learning methods.

## 3.2 Storyboards

### Student Point of View(Visual):

PERSONA: Sarah, visual learner

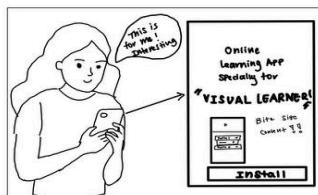
USER STORY/SCENARIO:



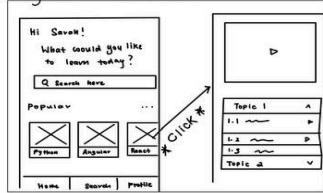
A typical lecture day for Sarah. As a visual learner, she finds it difficult to understand what is being taught in lecture. The slides are too wordy and heavy-content. She feels overwhelmed.



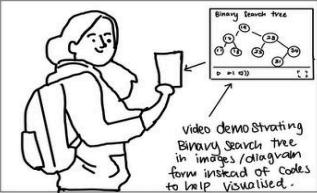
At home, Sarah tries to rewatch her lecture in hopes to better understand what was taught today. However, it was not effective and she felt frustrated.



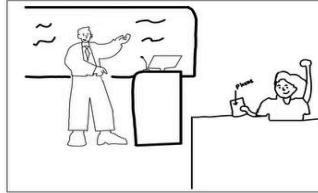
Sarah decided to take a break from studying. Sarah discovered an app that breaks down topics into bite size for easier absorption!



Sarah downloaded the app. The app breaks the topics down into engaging understanding segments.



Whether she's between class or lunch break, Sarah stays connected to her learning. The app allows her to utilize spare moments to keep her engaged with her studies anywhere and anytime.



With the help of the learning visual app, Sarah now feels confident and engaged during lecture.

PAGE #

PROJECT/TEAM:

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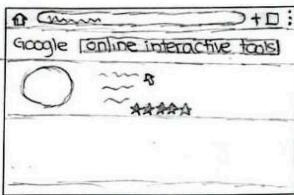
### Student Point of View(Kinesthetic):

PERSONA: Emily, a kinesthetic learner

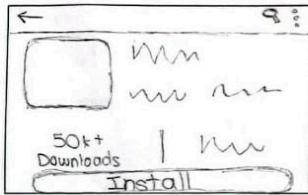
USER STORY/SCENARIO: Solving Kinesthetic Frustration



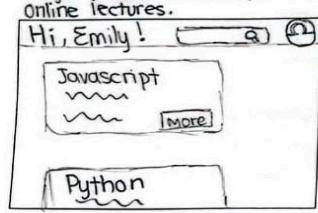
Meet Emily, a kinesthetic learner, feels frustrated during her online class. She finds it challenging to grasp abstract concepts through online lectures.



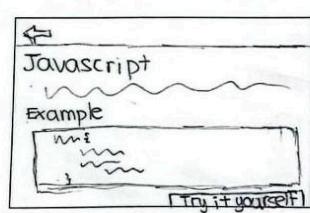
Emily finds the app while researching interactive learning tools.



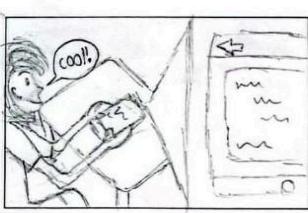
Emily downloads and installs the app on her phone, hoping it can help with her frustration.



Emily finds the topic she is learning on the app.



Emily actively participates in hands-on coding activities, which align with her learning style.



Emily's frustration transforms into excitement as she learns through kinesthetic interaction.

PAGE #

PROJECT/TEAM:

DATE:

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## Professor Point Of View:

**PERSONA:** Professor Anderson, a traditional instructor, seeks solutions to engage disinterested and frustrated students, discovers online-learning interactive tool

**USER STORY/SCENARIO:** Professor's teaching challenge



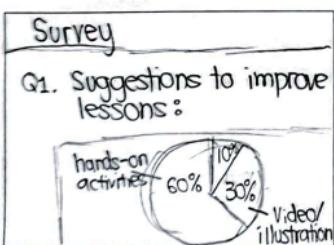
Professor Anderson teaches programming using traditional methods



Many students struggle to stay engaged and comprehend complex programming topics

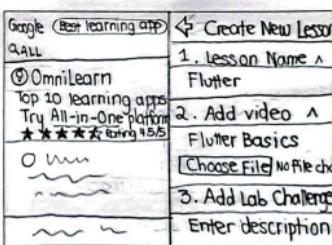


The professor experiences frustration as he notices the classroom's learning challenges.

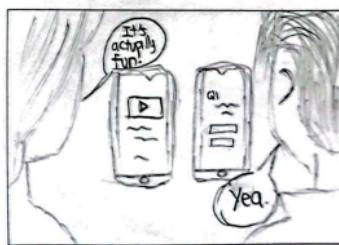


Professor Anderson asked feedback from students on how to make lesson engaging for them.

PAGE # PROJECT/TEAM:



While searching for teaching solutions, he discovers the application and starts using it; uploading contents on it.



Professor notices more students doing better in their work and participating more in class

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### 3.3 Lofi Prototype

#### Professor's POV

PROFESSOR POV

# HOME

APP NAME

Email: \_\_\_\_\_

Password: \_\_\_\_\_

Welcome Back < name >!

Logout

Pick up where you left off...

Python Basic Modules - Python

C Data Types Learn - C

Explore further...

DOCUMENTATIONS

Modules

FORUM

# Modules

modules

Q Search modules

Create

Python

Angular

Java

C

React

Flutter

# Create New Module

Create New Module

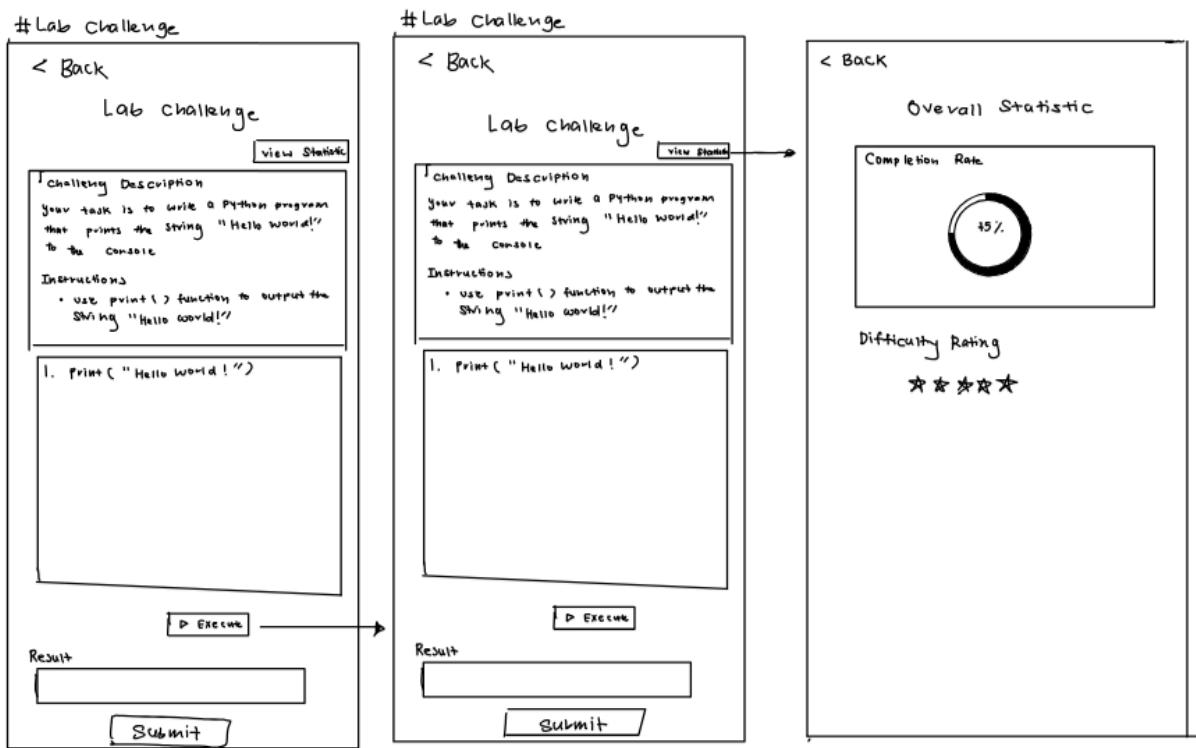
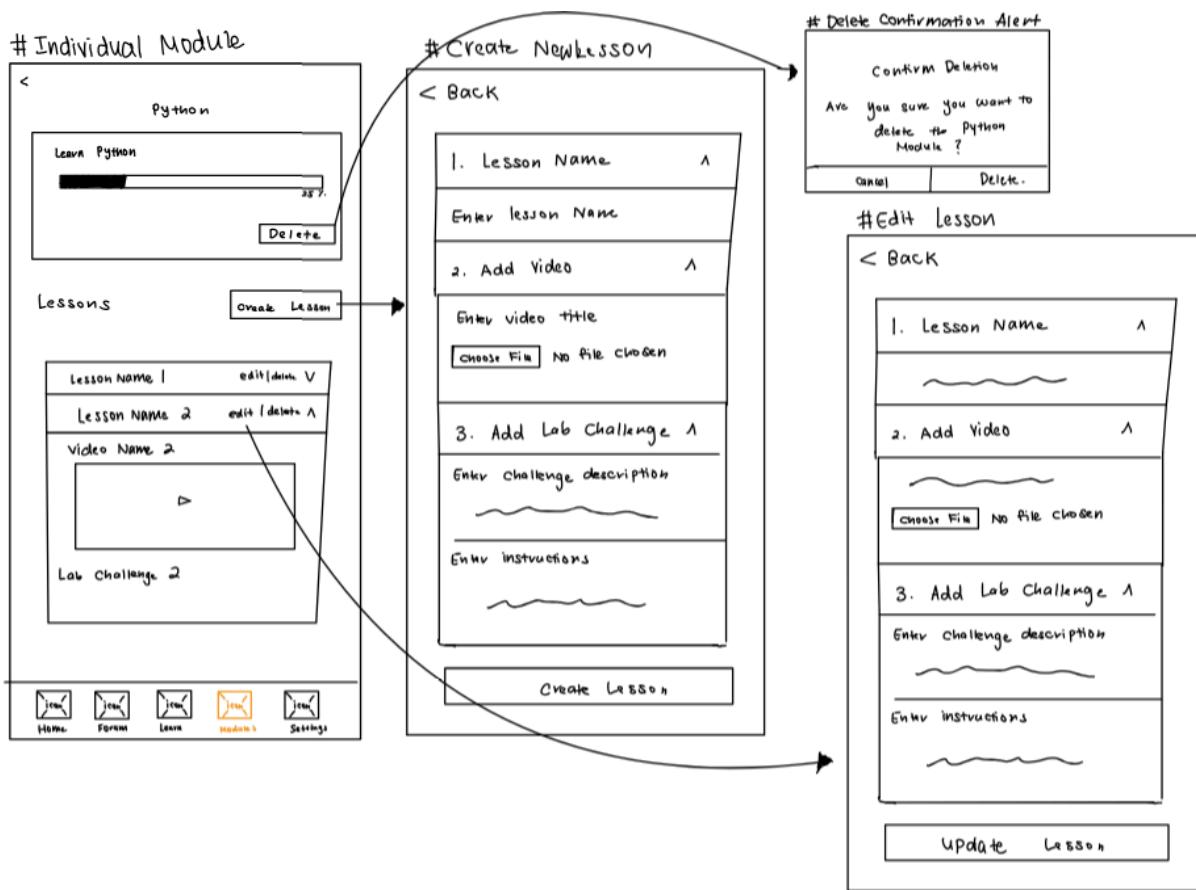
Cancel

Module Name: Enter module Name

Module Image: Choose file no file chosen

Create Module

4



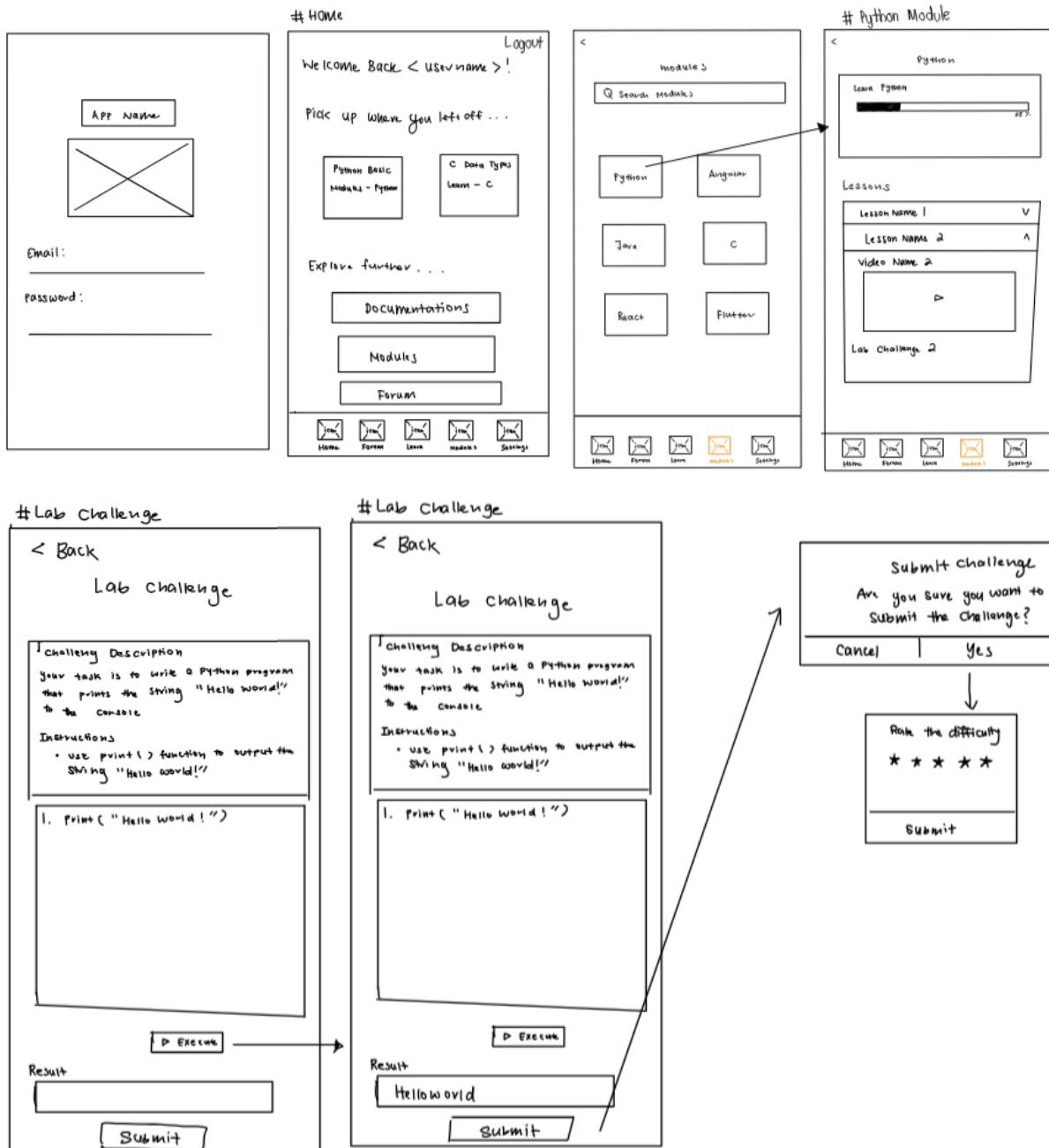
Login page: Start of the login page for professors, this is to authorise and get user identity to set their data to the applications needs.

Home page: Comes with a navigation bar at the bottom, includes documentation, challenges and forum. It also comes with a recently visited section for students to pick up where they left off. Logout button is located at the top

right. Navigation bar that shows the home, forum, learn(documentation), modules and settings, this allows easy navigation to each feature of the application.

**Modules page & Lab Challenge Page :** Allows Professor to edit/create a lesson in the modules, for example adding a new video or adding extra content like lecture slides. Will be prompted upon deletion of a module content. Professor will have the ability to access detailed statistics on the completion rates of each lab challenge. Additionally, they will be able to review student's feedback regarding the difficulty of the lab challenge.

### Student's POV



## # Forum

< Forum

Search Now  
Q Search modules

Embedded Systems

Human Computer Interaction

Cloud and Distributed Computing

Home Forum Learn Modules Settings

< INF2002

Discussion Board for INF2002  
New Thread

Q Search modules

Title 1  
Description 1  
Creator: Tom  
11/21/23, 12:07

Topic 10  
Experimenta Design  
Creator: Sarah  
10/1/23, 11:47

Home Forum Learn Modules Settings

## # Create new thread

< INF2002

Discussion Board for INF2002  
New Thread

Enter title  
Enter description  
Submit

Q Search modules

Title 1  
Description 1  
Creator: Tom  
11/19/23, 11:47

Topic 10  
Experimenta Design  
Creator: Sarah  
11/20/23, 12:07

Home Forum Learn Modules Settings

< INF2002

Topic 10  
Experimental Design  
Creator: Sarah  
Created on: 11/21/23, 12:07

Add Comments

Comments  
testing  
By: Connor on 12/22/23, 12:08

Home Forum Learn Modules Settings

## # Add Comment

< INF2002

Topic 10  
Experimental Design  
creator: Sarah  
Created on: 11/21/23, 12:07

Add Comments

Enter Comment  
Submit

Comments  
testing  
By: Connor on 12/22/23, 12:08

Home Forum Learn Modules Settings

## # Submit new comment

< INF2002

Topic 10  
Experimental Design  
creator: Sarah  
Created on: 11/21/23, 12:07

Add Comments

Enter Comment  
Submit

Comments  
Great  
By: Tom on 12/23/23, 11:45

testing  
By: Connor on 12/22/23, 12:08

Home Forum Learn Modules Settings

## # Documentation

< Learn

Search Languages  
Q Programming Languages

Python  
 C  
 Java

Home Forum Learn Modules Settings

< Python

Python  
Q Function Name

Print  
len

Description  
Returns the length (number of items) of an object

Parameters  
Iterable

Returns  
Int

input  
range

...  
...

Home Forum Learn Modules Settings

## # Settings

< Settings

Push Notifications

Dark Mode

Profile  
...

Contact Us  
...

Logout

Home Forum Learn Modules Settings

## # Profile

< Profile

Name:	Tom Bruce
Admin Number:	123456
Course of Study:	Computing Science
Year of Study:	Year 3
Gender	Male
Email	tom@gmail.com

Home Forum Learn Modules Settings

## # Contact Us

< Contact Us

Phone Number	123-456-7890
Email	Contact@example.com
Social Media	Follow us on Twitter
Address	123 Main St, City, Country

Home Forum Learn Modules Settings

Login page: Same as the professors, they are to be logged in to access the application's content.

Home page: Same as the professors, they will see the navigation bar, recently visited as well as the other implemented features in the application.

Modules page: Clicking on the modules brings the students to modules page that showcase their modules for their course. By navigating to the desired module, accordions that come with lesson videos, lab challenges can be displayed. Challenges page that shows quizzes based on each module to test on their skills and knowledge so that they know their understanding as well as from the Professor view they are able to know which part the students are more lacking in. Comes with a search function.

Forum page: Students can access forums where they can create threads or add comments. Search function can be used to allow faster navigation to desired points. Allows students to post clarifications based on the modules.

Documentation page: Students can learn the fundamentals of the modules that they require better understanding in. It has the functionality to show the documentations of the programming languages they wish to know.

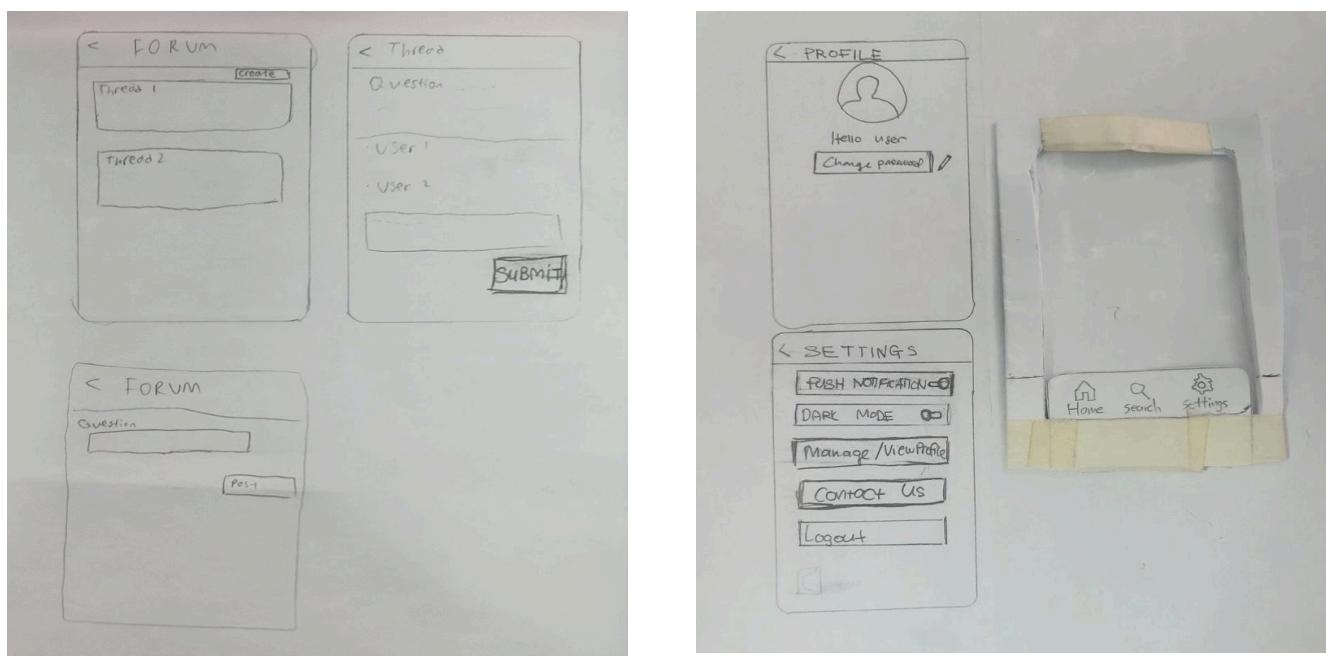
Settings page: Allows students to change to dark mode/light mode, enable notifications for updates, profile viewing as well as contact us section for seeking help or enquiries.

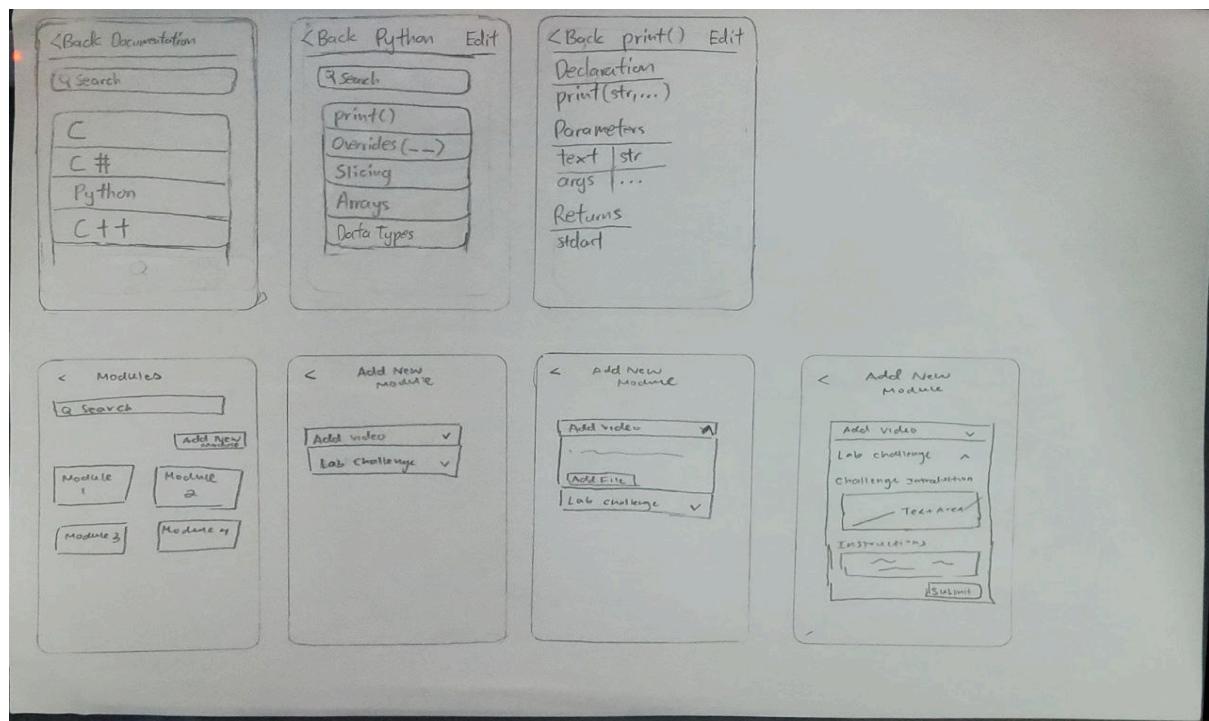
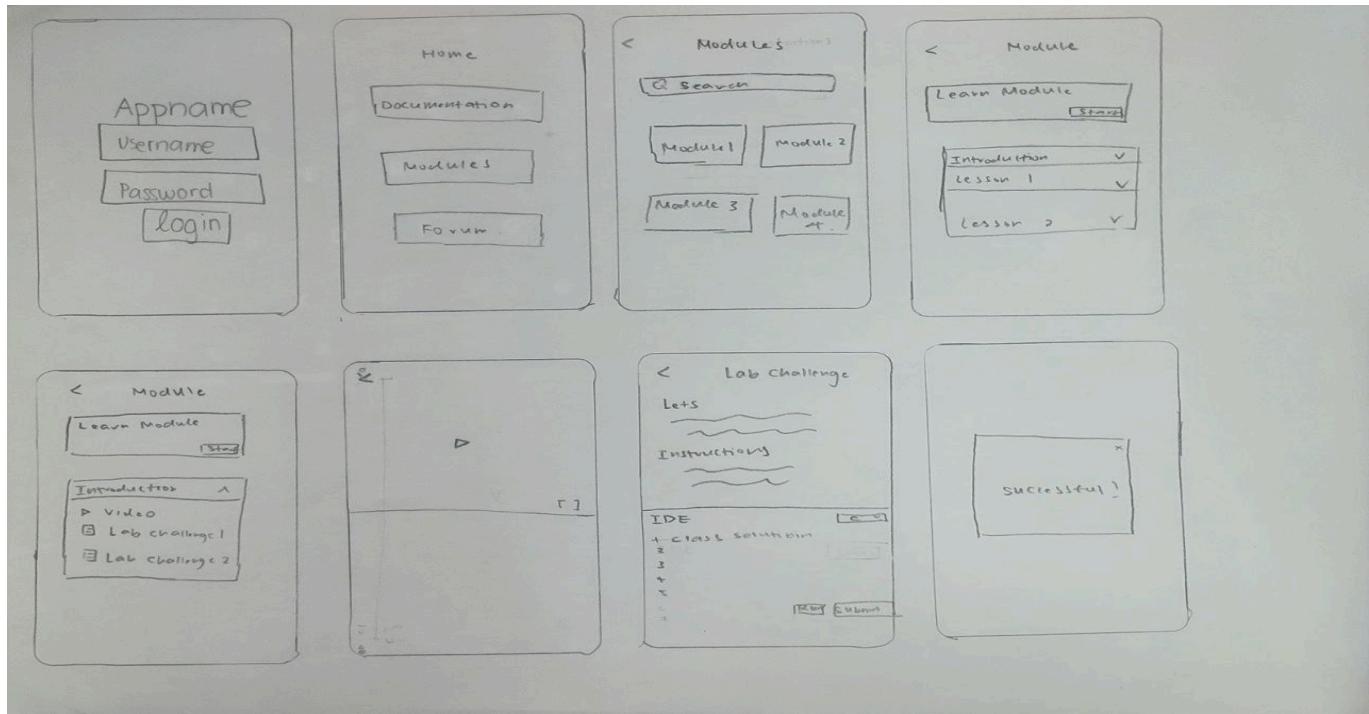
## 4. Heuristic & Think Aloud Evaluation

### 4.1 Heuristics Test (Team 44)

For this heuristic evaluation, we conducted the evaluation with team 44. We explained the features within our application and requested them to fill in the information and their opinion on our design. We obtained valuable information from the group based on the our paper prototype given below.

#### Paper Prototype





## Heuristics results

In the table below, it includes the heuristics test that team 44 evaluated for us and their opinion of our application itself.

Heuristic	Severity Rating	Description/ Issues
Visibility Of system status	1	IDE system does not show compilation status. Every screen shows clearly the user which page they are on.

Match between system and the real world	2	Typically, the home button should be positioned in the middle of the navigation bar, however, it is positioned at the left side of the navigation bar. Search button in the navigation bar only redirect users to the search results of the modules page instead of searching the entirety of the app.
User control and freedom	0	Every interacting point crafted in the UI is workable
Consistency and standards	1	There is already a search button on the modules screen, however, there is a presence of another search button at the navigation bar.
Error prevention	3	The IDE does not have a restart function for clearing the IDE. Cannot edit/ delete your own thread in the forum.
Recognition rather than recall	0	Navigation bar falls at the expected position, which is the bottom of the screen.
Flexibility and efficiency of use	4	Quick start button at the learn module page which act as a shortcut to start lesson for the respective module. Missing a search button at the discussion forum. Filter button missing for the discussion forum for the following functions: filter the discussions by modules and by date. (create category e.g discussion ) IDE is not flexible for complex problem. Does not allow the user of create a thread based on modules.
Aesthetic and minimalist design	1	The layout of the UI is reasonably formatted. Forum UI design can be improved.
Help users recognize, diagnose, and recover from errors	4	No error control is provided. (e.g search no results found)
Help and documentation	2	There isn't a user guide on how to use the application. There is no breadcrumb to guide the user on their navigation status.

### Heuristics Conclusion

The heuristics evaluation of the system conducted by Team 44 has unveiled several usability issues of varying severity. Notably, the absence of a restart function in the IDE and the inability to edit/delete forum threads pose major problems. The user-friendliness of the system is further impacted by problems including inconsistencies in the positioning and operation of UI elements, and a lack of search and filter options in the discussion forum.

## 4.2 Think Aloud (Team 25)

For this think-aloud, we conducted the evaluation with team 25. We explain the features within our application and requested them to speak out loud their thought process while attempting the task.

### Think Aloud Result

For the scenario, we requested them to test out our prototype without much guidance, The 4-5 task list is given below in the appendix section.

TASK	PROBLEM FACE					Possible Solution
	User 1	User 2	User 3	User 4	User 5	
Change the application to Dark Mode	User 2 unable to see visually if the dark mode is on/off, since the toggle switch doesn't have a filled-in color (only the outline was shown)					Enhance the toggle button to show clear indications when it's in the 'on' or 'off' position, signaling Dark Mode activation or deactivation.
Attempt module 1, then complete the lab challenge	User 2 was confused after clicking on the start button under the module page					Remove the Start button on the module card to prevent any confusion
Read through (concept) for (programming_langauge)	Users do not face any difficulty No feedback					NIL
Post a new thread in the forum	User 4 felt button to create new thread is small, could be visually bigger					Make the create button larger.
As a professor, create a new module by adding video and challenge	User 5 felt that we needed to show to users who are currently logged in, on the home page. and Open up all the accordions to make it clearer instantly for users what information they need to fill out.					Display the user's name on the home page. For example "Welcome Dylan"  In the add new module page, to open up all

		accordions by default for more visual clarity.
--	--	--

### Think-aloud Conclusion

The think-aloud evaluation of the system conducted by Team 25 has provided us with necessary feedback on our prototype. Issues like confusion to the visibility to the button and even flow on how to access the lab challenges.

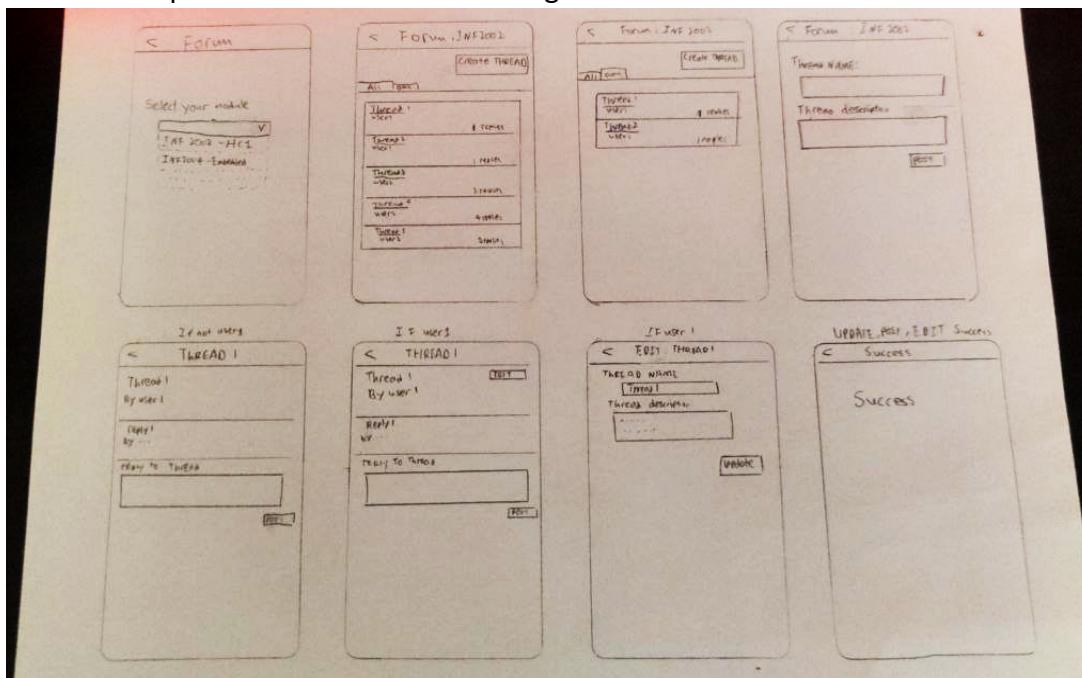
### **4.3 Overall issues found with your prototypes**

After completing both evaluation methods, below are some of the feedback given by both two teams.

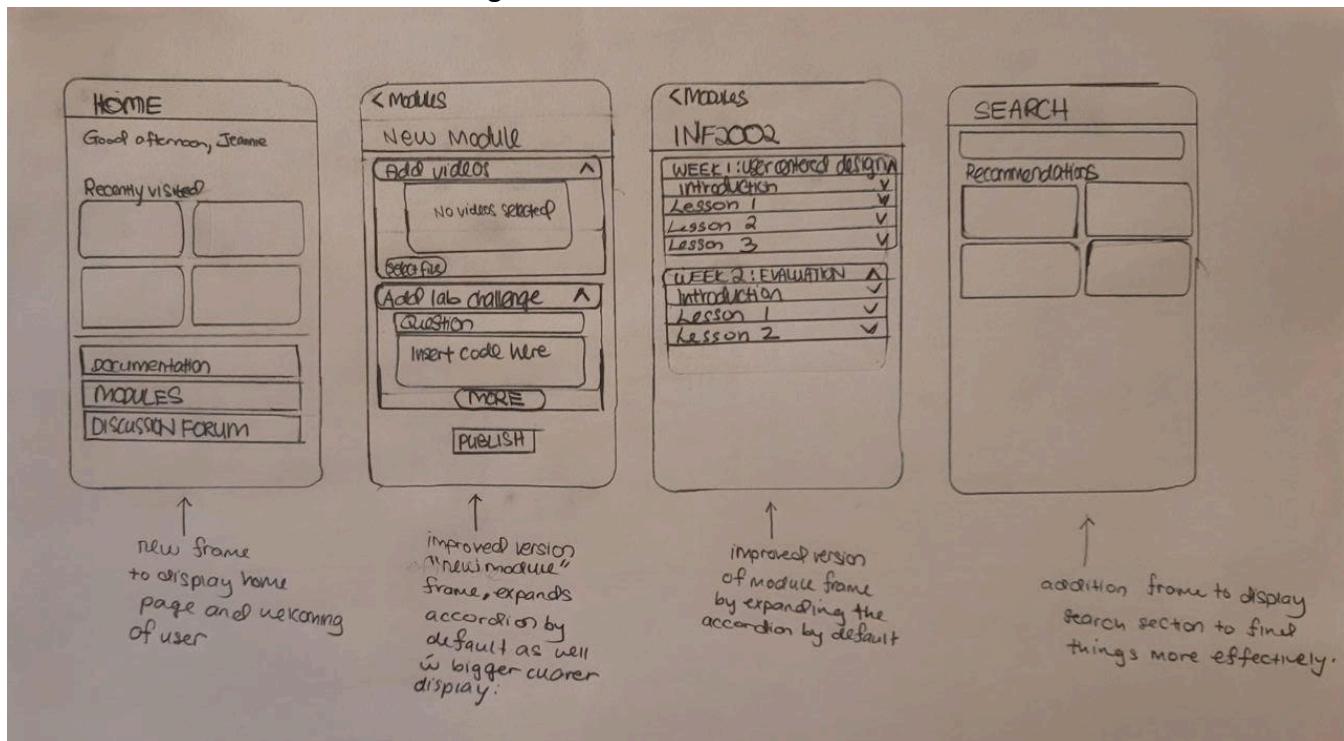
1. Navigation flow of modules could be amended to prevent confusion
2. Missing errors pages (invalid input, etc).
3. Lacking a global search function (Currently search is meant for modules). User assumption was a global search throughout the app.
4. Button for the creation of thread could be bigger.
5. Thread creation was general rather than specific to a particular module. Design of the threads could be improved. Lacking flexibility to edit or amend thread.
6. IDE features are lacking in restart buttons and not flexible for complex problems.
7. User does not know who they are logged in as (Professor/Student).
8. Data entering process for the creation of new modules was inefficient because it took unnecessary time and effort to enter information in 1 accordion and then having to open up the next accordion to input another set of information.

### **4.4 Revised solution**

1. The thread UI could be improved, a bigger and visible button, amend thread for user, and link thread to respective modules rather than general.



2. IDE could be fitted with features and more buttons that are necessary for users to practise and provided with an error terminal indicating any compilation errors or even results errors, indicating either logic or syntax error.
3. Create a personalized greeting such as "Welcome Dylan" on the homepage.
4. Expand all accordions by default on the add new module page, thereby ensuring immediate and explicit clarity on the information users are required to provide.
5. A more simplified version of module navigation could be done without confusing users. Such as removing the start button at the top and allowing the user to directly select which submodules they would like to access.
6. A general search bar instead of a search that is meant only to link to a module page. With this page, it can search for details throughout the app, such as thread, documentation and even a specific module that the user is looking for.



#### 4.5 Overall Conclusion for heuristics and think-aloud

In conclusion, the feedback from both the heuristics evaluation and the think-aloud test has provided us with valuable insights. The feedback can then be analysed and used to guide the refinement of our app's design. Addressing these identified issues will be crucial in delivering a more user-friendly app which can then result in a more efficient educational platform. The iterative nature of our design process ensures that these suggestions will be considered and incorporated in the further development of **OmniLearn**.

### 5. Implementation

#### 5.1 Software tools and methods

##### Ionic

Framework for building cross-platform mobile applications using web technologies such as HTML, CSS, and Javascript. Used as the frontend of the application. It is used because it has the ability to cross-platform mobile applications. With a single codebase, we are able to build applications that can run both on iOS and Android devices. It comes with a Native-Like User Interface that comes with pre-built UI components that

follow the design guidelines of iOS and Android. Therefore, ionic is chosen as the frontend as it is suitable for our mobile application and provides many advantages as mentioned.'

### Firebase

Firebase is a platform for developing web and mobile applications, providing a variety of services and tools to streamline the development process. It serves as a realtime database and a backend for the product. Firebase is chosen as our backend database as a realtime database is useful for applications that require collaborative features or react to changes instantly. It also supports multiple platforms, including iOS and Android, making it suitable for building cross-platform applications.

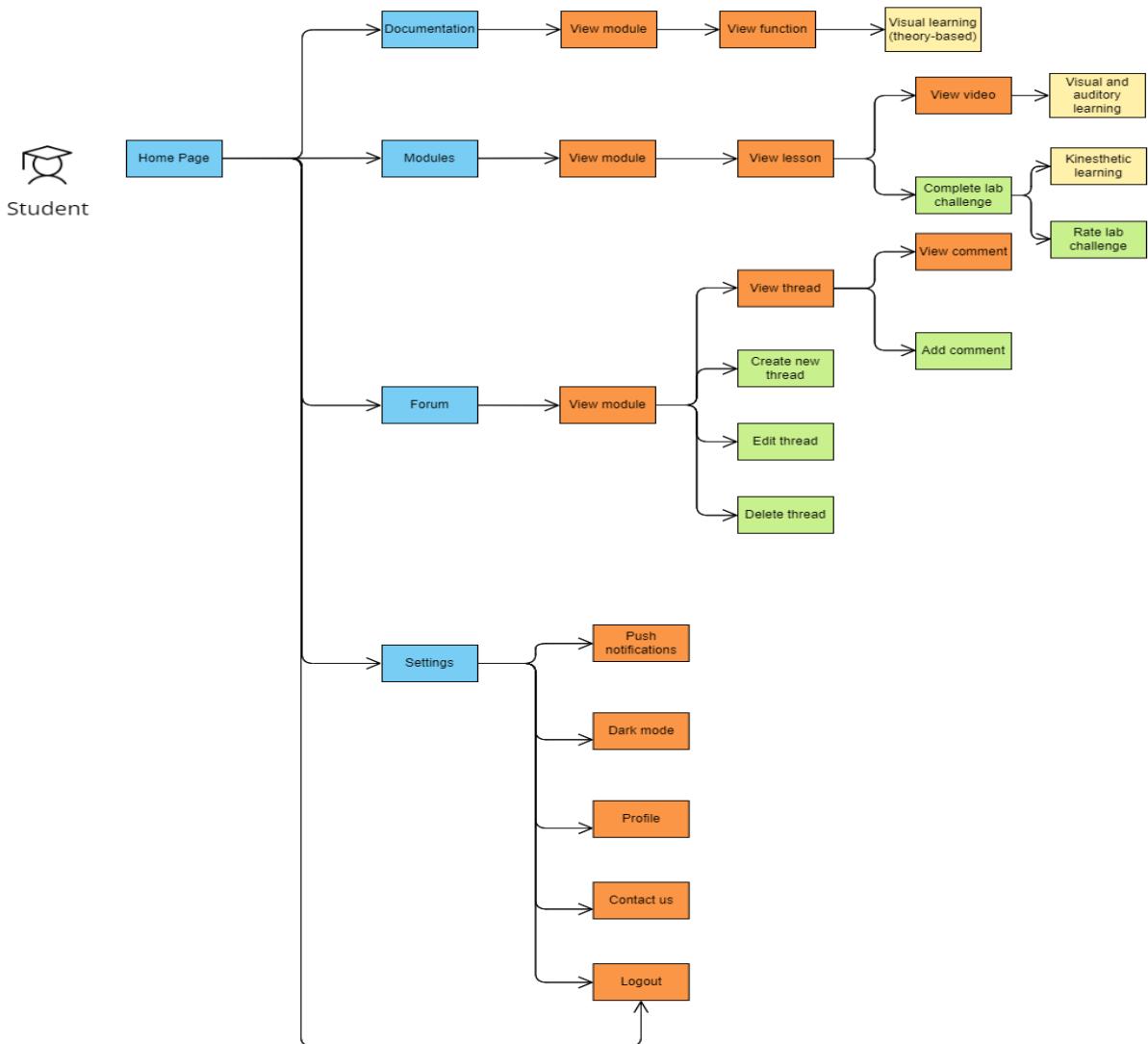
### Implementation Plan

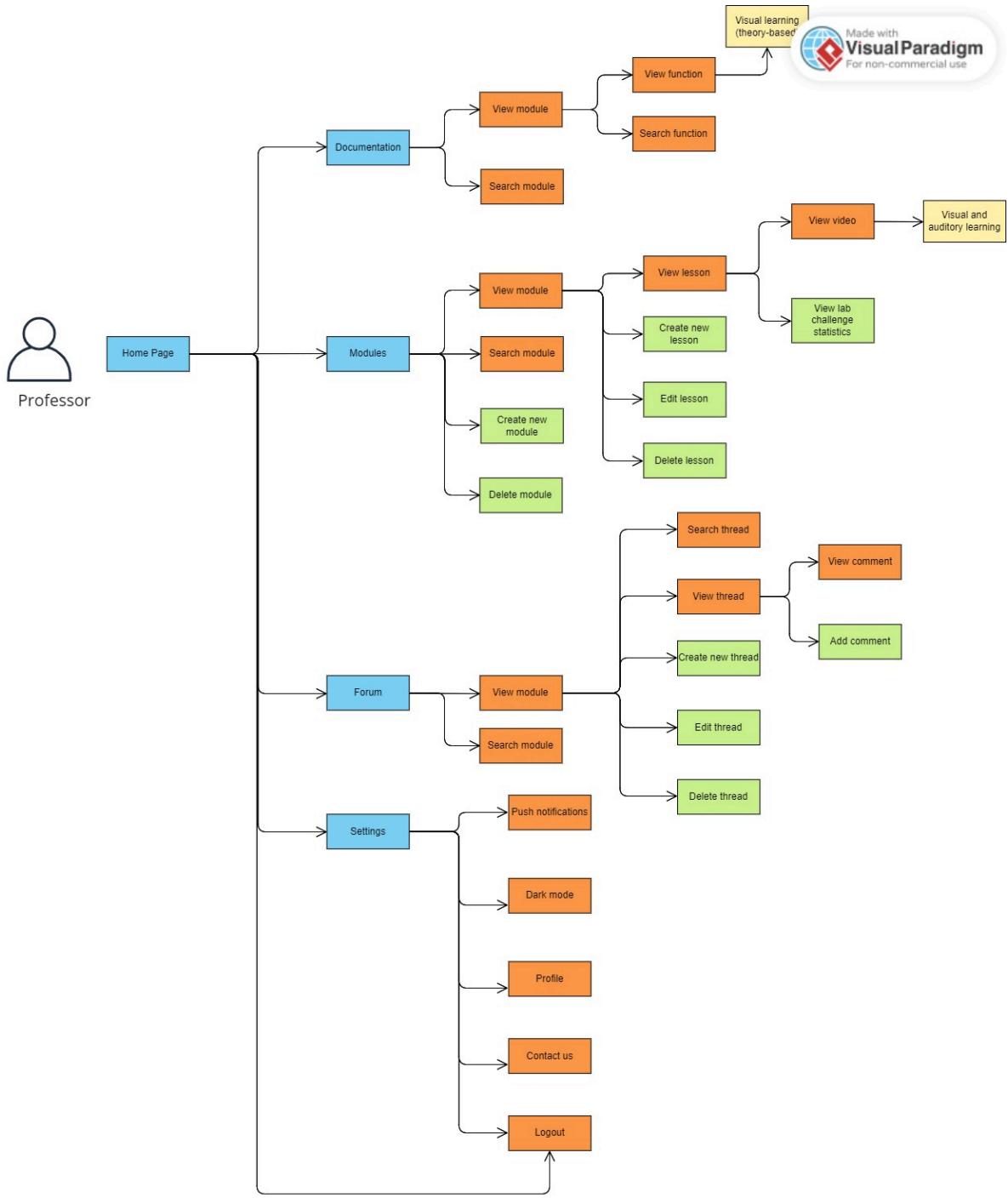
To implement the prototype we require a frontend and backend which are Ionic and Firebase respectively. We then use Visual Studio Code to program our implementation of the application. Typescript is used to code the application. Each component serves as the features that consists of the Login page, Home page, Forum, Modules, Learn(Documentation) and Settings. The process of the application starts with user login where they are required to login to access the other components of the application, after logging in they are allowed to access each component. Their data is stored in the Firebase so even if they were to logout and log back in the id of the user will be called to the database to retrieve its respective data.

For each feature itself, we all did our part concurrently, over **2-4 weeks** till the end of the project and integrate together once in a while with the GitHub repository merge function. As we are all doing our individual components, this allows for a smooth integration without many merge conflicts. Additional features were further added on after the completion of the main features such as curation to allow the administrator view to add on additional modules and videos into our application.

Name	Feature	Time Taken
Ryan	<b>Backend: DB</b>	<b>1 week</b>
Ryan	<b>Login</b>	<b>2 week</b>
Desmond	<b>Forum and Threads</b>	<b>2 week</b>
Wei Jun	<b>Documentation Section</b>	<b>2 week</b>
Joyce and Farah	<b>Module Section and Curation</b>	<b>2 week</b>
Iskandar	<b>Main Menu, Search and Settings</b>	<b>2 week</b>

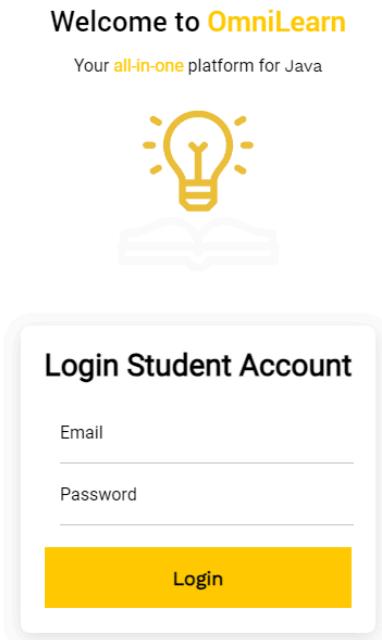
## Block Diagram



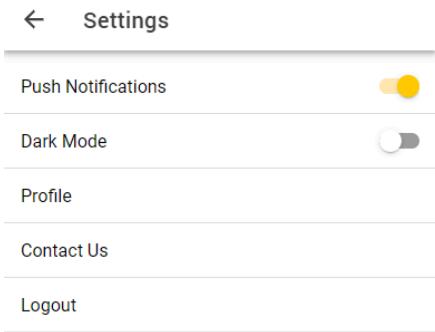


## Screenshots of our implementation

Login:



Settings:



## Forum:

The first screenshot shows a 'Forum' screen with a search bar and two icons: 'Engage In Discussions' (yellow head) and 'Cloud' (red head). It lists three modules: 'Human Computer Interaction', 'Embedded System', and 'Cloud'. The second screenshot shows a 'Discussion Board for CSC3104' screen with a 'New Thread' button. The third screenshot shows a 'Cloud' module detail screen with a 'Comments' section containing one comment.

## Documentation:

The left screenshot shows a 'Learn' screen with sections for 'Learn', 'Un-learn', and 'Re-learn'. It includes a search bar for 'Programming Languages' and sections for 'Python', 'C', and 'Java'. The right screenshot shows a detailed view for 'Python' with a search bar for 'Function Name' and a list of functions: print, len, input, range, type, int, str, list, max, min, sorted, sum, enumerate, and zip.

## Modules:

← Modules

search modules

CREATE

Python

Learn Python

25%

DELETE

Lessons

CREATE LESSON

Python Basics

Lesson 1: Python Basics

Views #0 Python for Beginners | ... It's Easy

Python Full Course

Lab Challenge 1 : Python Basics

Data Structures in Python

Home Forum Learn Modules Settings

## Lab Challenge

← Lab Challenge

VIEW STATISTIC

Challenge Description

Your task is to write a Python program that prints the string "Hello World!" to the console.

Instructions

- Use the `print()` function to output the string "Hello World!".
- Make sure to include the quotation marks around "Hello World!".
- Run your code to verify that it prints the correct output.
- Click the Submit button when you're done.

Completion Rate

75%

Challenge Difficulty Ratings

★ ★ ★ ★

1

Home Forum Learn Modules Settings

## Curation Page:

The screenshot shows a 'Create New Lesson' interface with three main sections:

- 1. Lesson Name:** Contains a dropdown menu and an input field for 'Enter lesson name'.
- 2. Add Video:** Contains a dropdown menu and an input field for 'Enter video title'. It also includes a file upload section with 'Choose File' and 'No file chosen'.
- 3. Add Lab Challenge:** Contains a dropdown menu and two input fields: 'Enter challenge description' and 'Enter instructions'.

At the top right of the interface is a 'CREATE MODULE' button. At the bottom right of the third section is a 'CREATE LESSON' button.

## Implementation Vs Prototypes

Features	Implementation	Prototypes
Login	Comes with a validation of login to notify invalid password/username.	Does not come with any validation for the inputs.
Home	Contains recently visited and other features with navigation bar at the bottom. Recently visited constantly updates based on where user left off.	Prototype unable to display the recently visited. As it does not have a storage for the data.
Forum	User can create, read, update and delete threads. Forum is reactive.	User can only view the forum and content but unable to create, update and delete.
Modules	Modules contain content that can be shown and read through. Videos can be played as well, accordion can be extended to show the contents as well.	Modules can show content but unable to read through. Videos cannot be played. Only the first accordion can be extended which is the default.
Learn(Documentation)	The documentation accordion	The documentation accordion

	can be extended to display the information of the modules learning content, the accordion has labels. It goes from basic to advanced level.	only extends on the first one and shows the label for each one of them.
Settings	Contains the same with prototype but with the addition of modal pop up that displays the information of the contact us as well as profile view.	Contains a model of what the settings page looks like with inclusion of contact us, push notifications etc.

## 6. Experimentation

### Hypothesis statement

Usage of an application that features coding documentations, courses, and forums will enhance programming language learning for all, accommodating various learning styles for students as compared to an online platform that uses search engines.

### 6.1 Experiment Design

#### Between subject:

1. No learning effect
  - 1.1 Reduce Carryover effects : Since each participant is exposed to only one condition, the risk of carryover effects from one condition to another is minimised. This is crucial in experiments where exposure to one condition could influence responses in subsequent conditions.
  - 1.2 Lower chance of skewing results and outcome of experiment
2. Less fatigue : Since participants are exposed to only one condition, it lessens the likelihood of fatigue that could influence their performance or responses, leading to more reliable results.

#### Task Performed

1. Print statement
  - Search online with w3schools, GeeksforGeeks etc
    - Compile Python code to print a “Hello World” statement
  - Use Python documentation in application
    - Compile Python code in application to print a “Hello World” statement.
2. Understanding the modules
  - Search for videos online regarding Python and try out a practice in w3schools.

- Use the modules in application watch videos and try out the lab challenge

### Variables of the experiment

1. Independent variables:

Utilizing our application (experiment group)

No utilization of our application (control group)

2. Dependent variables:

Satisfaction rate (ordinal, 1-5 rating, survey)

3. Control variables:

Tested with same module (or subject)

Students have similar academic knowledge (or programming background)

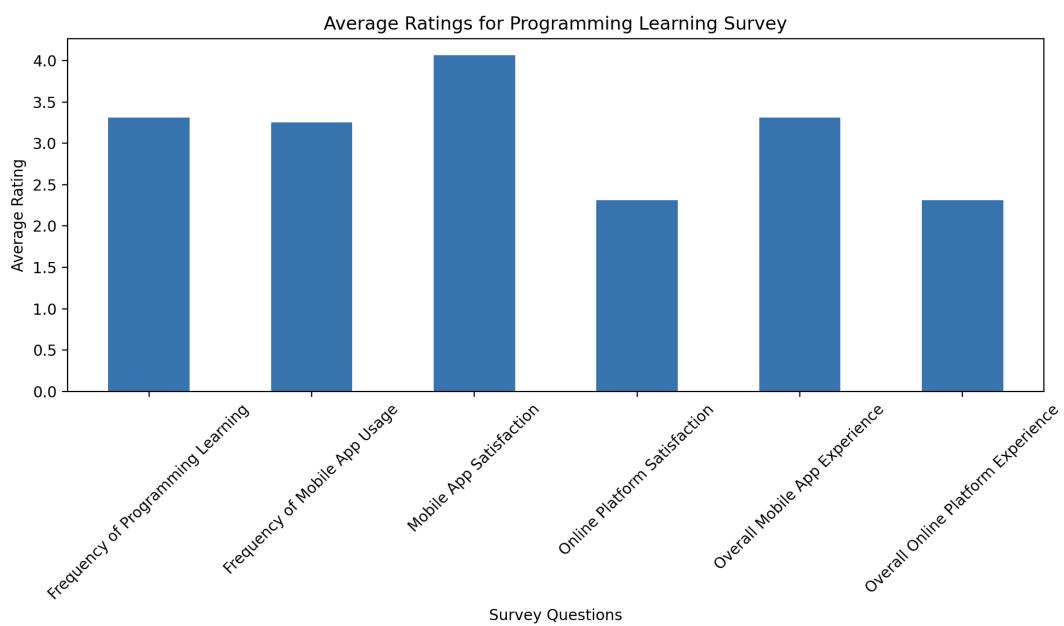
Similarly aged participants

### Type of data

1. Data collected will be in ordinal data type.
2. The method to collect data to test the hypothesis is via a Lab based experiment under a controlled environment. Users will be given the use of the application as well as the usage of search engines.
3. Experimentees will be tasked to perform the tasks that were given to them.
4. Quantitative data collected will be done via a small online survey done after the tasks. Results of code completion will also be collected for verification on the execution.
5. Likert scale will be used to measure satisfaction levels of experimentees.

## 6.2 Experiment Analysis

### Graph Results



### Statistical Used

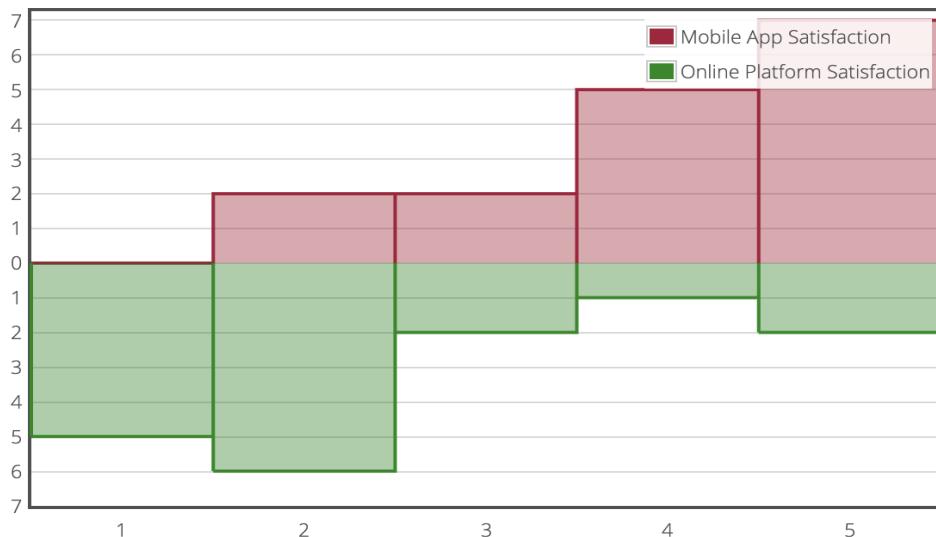
Non parametric tests will be used since the data collected is ordinal data and sample size requires only 10 experimentees which is a small amount.

### Statistical Test Result

#### **Mann-Whitney**

- $U = 43.500$
- z-score = -3.266
- Asymptotic significance (1-tailed)  $p < 0.001$
- Based on a significance level of 0.05, there is a statistically significant difference between 'Mobile App Satisfaction' and 'Online Platform Satisfaction'.
- Effect size  $r = -0.577$

### Visualization



The graph above is a bihistogram that allows you to compare the distribution of Mobile App Satisfaction (top) with the distribution of Online Platform Satisfaction (bottom).

### Hypothesis Conclusion

Conclusion: The survey is statistically significant, given that the p-value is  $< 0.001$ , which is less than the threshold of 0.05. As such, the Null hypothesis is rejected.

### **6.3 Experiment Conclusion**

#### Internal Validity

This experiment can only be applied and tested on students in Computing Science @ SIT. Hence, we are unable to say the same for students from other autonomous universities.

#### Confounding Variables

1. Preferences for web/desktop resources
2. Different learning styles, may prefer to use generative AI for examples and documentation.

## **7. Conclusion**

Overall, through the entire process, we started off with finding the problem statements pertaining to the issues many students in tertiary educations are facing. We dive deep to the area we wanted to focus on which is the IT university students. Before we could start with our prototyping we need to find out what the user needs are, we performed the needfinding methods and analyse on what are the things that we can ideate from and put it into our design board. From there we are able to come up with few design ideas which narrows down to creating a mobile application. We identified key features based on the needs and put it as a feature. Evaluation is performed by the evaluators where we received feedback to further improve based on the remarks. After finalising everything, implementation is done with the planning of the architecture that will build the application. Last but not least before we ensure that our prototype really meets the demands of the user and come up with a hypothesis, to find its effectiveness we conducted experimentation to prove the hypothesis. Therefore after proven, we were made aware that the creation of our prototype to meet the users' needs and come up with a solution was a success.

## Appendix

Survey Question Results: [Link to survey data \(Excel\)](#)

1. Do you come from an IT background

27 responses

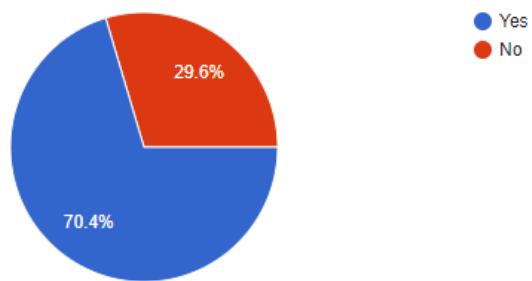


Figure 1 .

2. How many programming languages are you well-versed in?

27 responses

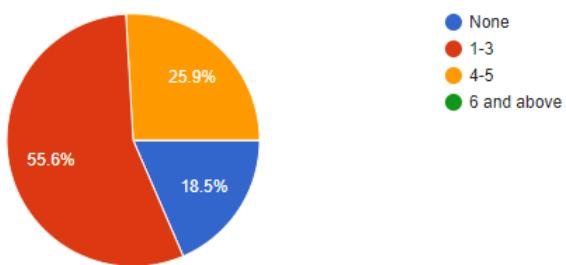


Figure 2 .

3. On a scale of 1 to 5, how challenging would you rate your experience when learning a new programming language Copy

27 responses

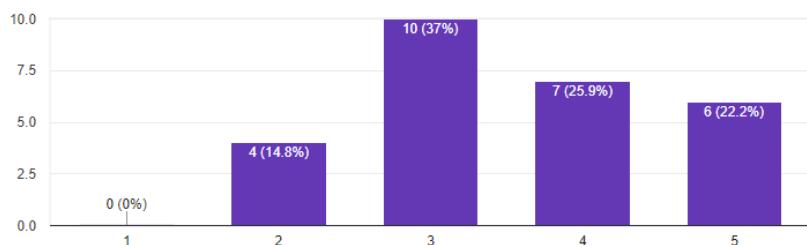


Figure 3.

4. When you're picking up a new programming language, what are some problems you faced? (Select all that apply) Copy

27 responses

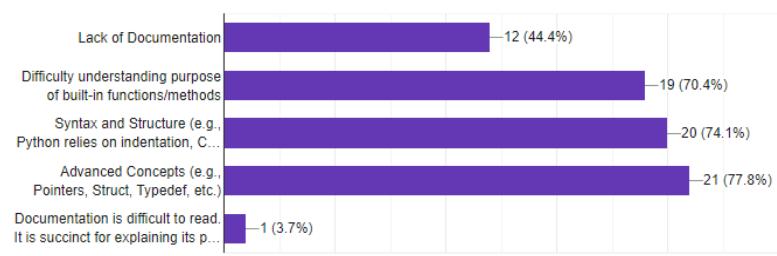
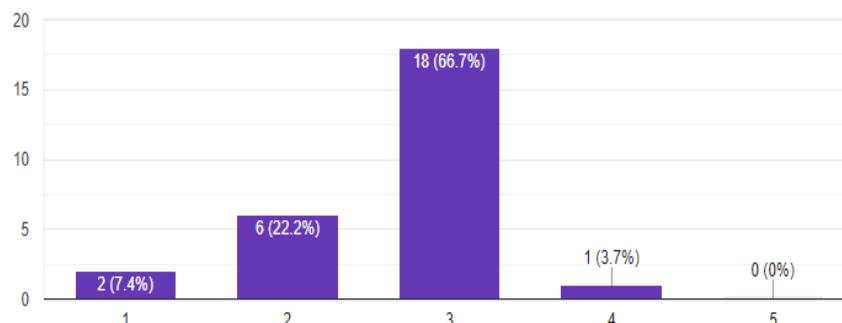


Figure 4.

5. On a scale of 1 to 5, how would you rate the effectiveness of the current teaching styles employed by your professors in facilitating your learning?

[Copy](#)

27 responses



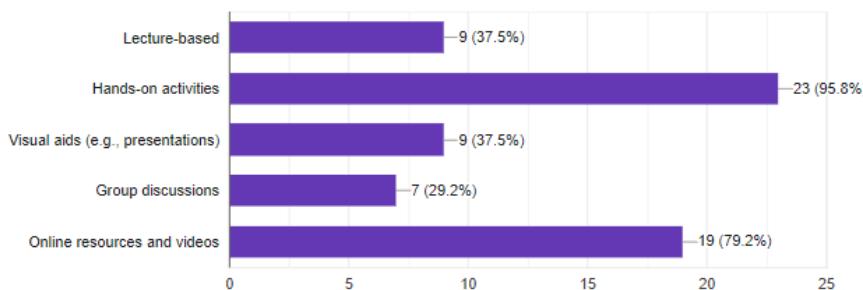
**Figure 5.**

6. Which specific teaching style(s) do you find most conducive to your learning?

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(Select all that apply)

24 responses

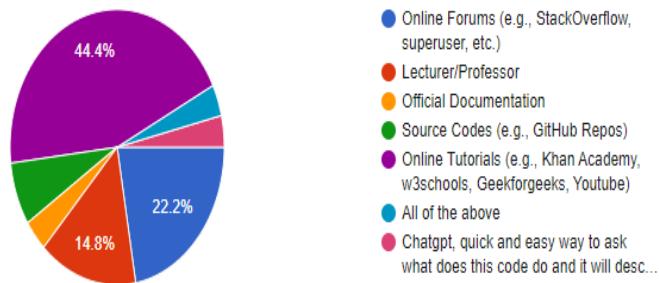


**Figure 6.**

7. Which of these resources do you most frequently use to clarify programming concepts?

[Copy](#)

27 responses

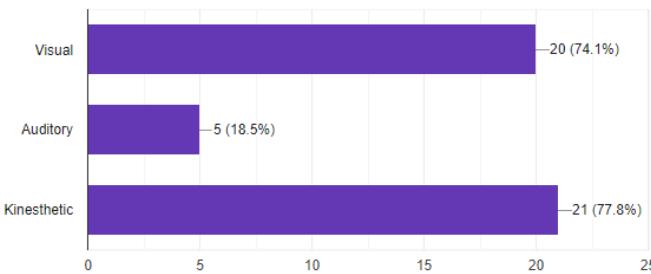


**Figure 7.**

8. Do you believe your learning style is best described as visual, auditory, kinesthetic?

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27 responses

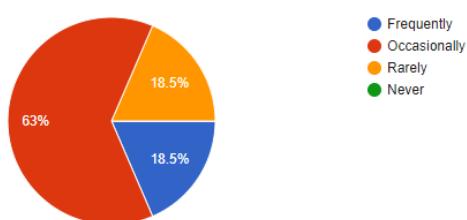


**Figure 8.**

9. How often do you find it challenging to adapt to a professor's teaching style that does not align with your preferred learning style?

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27 responses

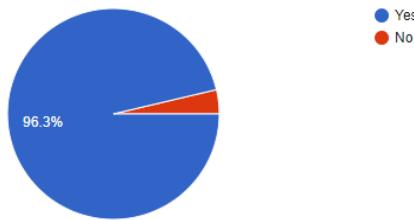


**Figure 9.**

10. Would you find it helpful to have a centralized resource (e.g., a website, platform, or academic advisor) that provides guidance and resources tailored to your learning style?

[Copy](#)

27 responses

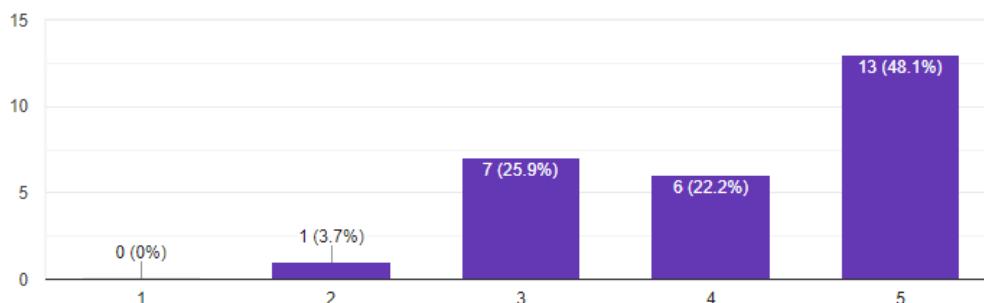


**Figure 10.**

11. How likely are you to actively engage with and utilize a centralized resource if it were made available to you?

[Copy](#)

27 responses



**Figure 11.**

Do you have any additional comments or suggestions for improving the learning experience by addressing the diversity of teaching and learning styles?

27 responses

Maybe the slides should be animated instead of making it in PDF which does not illustrates how the algorithm work very clearly

Use an algorithm to generate content needed to learn by the student in accordance to their preferred learning style

Nil

Provide the language to be learnt before the module begins, so that students will be able to self practice before the module begins.

Lecturer needs to have a better way to convey their message across. Sometimes they will subconsciously thinks that we understand certain terms.

no

provide additional workshop / have a TA

**Figure 12.**

## Heuristic Evaluation

Youtube Video Link for Heuristic Evaluation: <https://youtu.be/RBecJYNKwUA>

Usability Script:

- Give them a recording permission form and a pen

Hi, \_\_\_\_\_ . My name is \_\_\_\_\_ , and I will be going through this session with you today.. Before we begin, we would like to go through a few information.

Our application is called **OmniLearn**, which is an educational platform app, designed to empower students to master coding through a dynamic and engaging learning experience. You will be role-playing as a student in 4 of the task, and lastly as a professor in the last task. The student wants to make use of this application to try and understand the programming language concept and complete the module lab challenge as given. The professor wants to help students learn further by creating more content as well.

The think-aloud session will take for about 5-10 minutes. We are tasking people on the mobile design created and see whether it works as intended. Do note that we are testing the site, not you. Therefore, do not worry about making any mistakes.

The purpose of this is to ensure its usability and we also hope to get your feedback. We would like you to as much as possible try to think out loud, like what you feel, and think. We hope to get your honest opinion, for us to improve the mobile application.

With that being said we would like to ask for your consent to record the session and we assure you that it will be confidential. It will only be used for reviewing on how to improve the application.

If you could, we would like to request to sign the recording permission form. This is to indicate your permission to allow us to record this session and will only be used by the people working on the project.

- Give them a recording permission form and a pen
- After they sign it, START the VIDEO RECORDER

Do you have any questions for me at this moment?

Before we start, we would like to ask you a few questions. How do you normally learn a new programming language?

Do you have a particular site for your studies for any programming language?

Ok, we're done with the current question and let us begin the think-aloud test.

- Begin the first task, by reading it out loud
- Help the user if needed or any questions from the user.
- Repeat for the remaining test.

Thank you, for participating in this test. It is very helpful to us. Do you have any other questions or opinions that you would like to express?

- |   |
|---|
| <input type="checkbox"/> Stop the recording and save the file |
| <input type="checkbox"/> Thank the user and escort them out   |

## Task List:

1. Change the application to Dark Mode
2. Attempt module 1, then complete the lab challenge
3. Read through (concept) for (programming\_langauge)
4. Post a new thread in the forum
5. As a professor, create a new module by adding a video and challenge

## Implementation Plan

Title	...	Assignees	...	Status	...
1 <span style="color: green;">●</span> Main Menu, Search and Setting: Implementation #1		IskandarHan	▼	<span style="border: 1px solid blue; border-radius: 50%; padding: 2px;">Done</span>	▼
2 <span style="color: green;">●</span> Login: Implementation #2		ryanchuaks1	▼	<span style="border: 1px solid blue; border-radius: 50%; padding: 2px;">Done</span>	▼
3 <span style="color: green;">●</span> Module: Implementation #4		Faraway2307 and jo...	▼	<span style="border: 1px solid blue; border-radius: 50%; padding: 2px;">Done</span>	▼
4 <span style="color: green;">●</span> Documentation Section: Implementation #5		leungwj	▼	<span style="border: 1px solid blue; border-radius: 50%; padding: 2px;">Done</span>	▼
5 <span style="color: green;">●</span> Forum and Threads: Implementation #6		Devilsbats	▼	<span style="border: 1px solid blue; border-radius: 50%; padding: 2px;">Done</span>	▼
6 <span style="color: green;">●</span> Backend: Database Implementation #7		ryanchuaks1	▼	<span style="border: 1px solid blue; border-radius: 50%; padding: 2px;">Done</span>	▼

+ You can use Control + Space to add an item

## Implementation

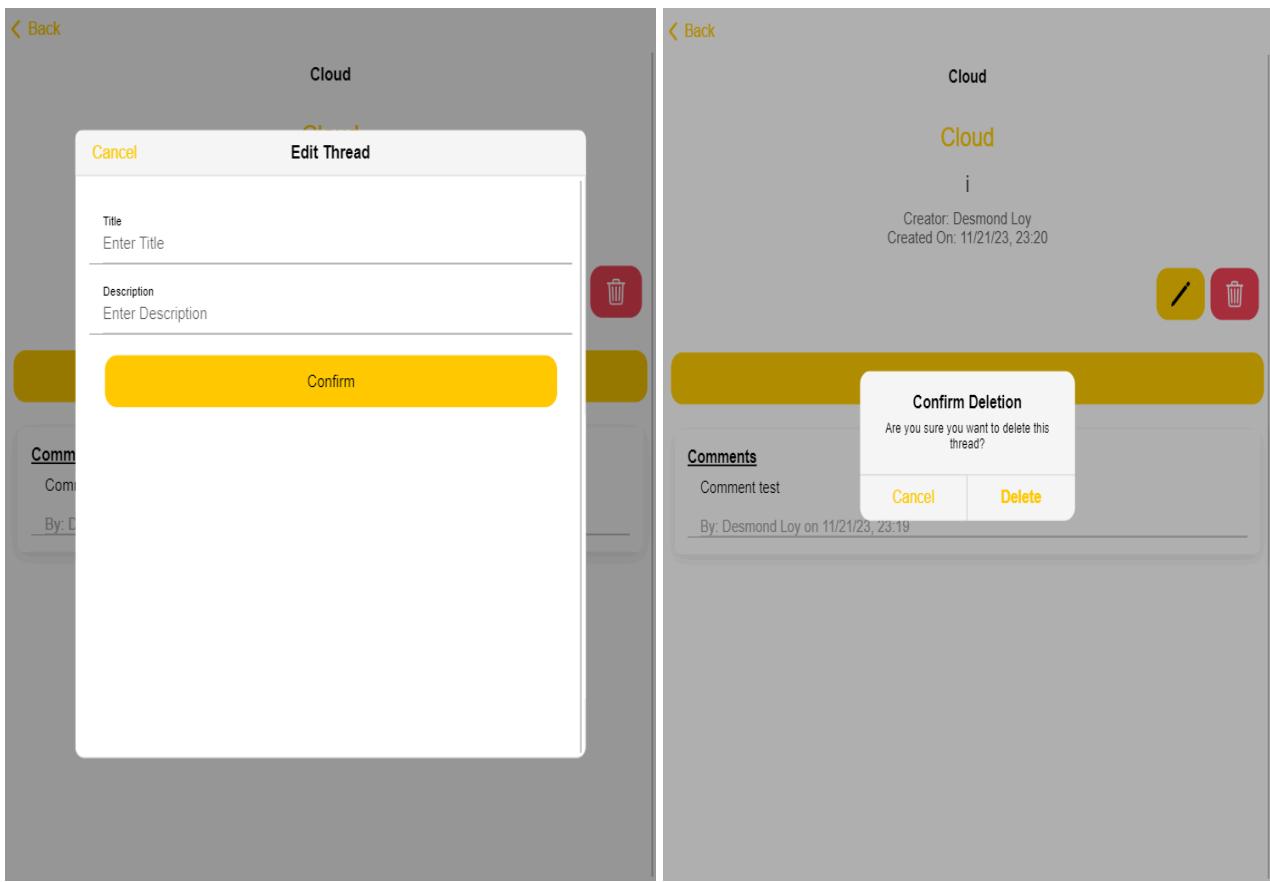
### Homepage:

The screenshot shows the application's homepage. At the top, there is a navigation bar with a yellow arrow icon and the word "Home". Below the navigation bar, a message says "Welcome back" followed by "Student 1" in yellow text. A sub-message "Pick up where you left off.." is displayed. The main content area features a grid of four cards:

- Python Basics** (Module - Python)
- Python print()** (Learn - Python)
- C Data Types** (Learn - C)
- How to switch on an LED?** (Forum - Embedded Systems)

Below the grid, there is a section titled "Explore" with the sub-instruction "Discover new modules". At the bottom, there is a yellow navigation bar with tabs: "Learn" (which is active), "Home" (with a house icon), "Forum" (with a speech bubble icon), "Learn" (with a magnifying glass icon), "Modules" (with a book icon), and "Settings" (with a gear icon).

### Forum Edit/ Delete



Youtube Video Link for Demo:

<https://youtu.be/3AsXpz0OhK8>

## **PARTICIPANT CONSENT FORM**

*The consent form is to participate in the INF2002 Human Computer Interaction project conducted by second year undergraduate students in the Singapore Institute of Technology, as a part of their assessed coursework*

**The objective of the project is to:** The objective of our project is to provide an efficient and user-friendly website that users can use to improve their learning, accommodating to all various learning styles for students.

The features *include documentation of various programming languages in 1 platform*. Also, it includes *lab challenges so that students can practise their knowledge*.

We have finished implementing the above applications with all the required functionalities and now are in the stage of evaluating the final software product.

### **Task List**

1. Go online and research and compile a python code to print a “Hello World” statement.
2. Using Python documentation in our application, Compile the python code in application to print a “Hello World” statement.

The total time taken for each task will be about 3-5 minutes each.

***Please note that it is the web application/functionality we are evaluating and not your technical skills.***

#### DATA PRIVACY

- Your answers to our survey will be made anonymous and held in strict confidence, and stored in a password-protected computer in the Computing Science department. The access will be restricted to only the people involved in this project. This data won't be shared with any third-party or used for commercial purposes.

You may withdraw from the experiment at any time without prejudice, and any data already recorded will be both discarded and deleted. If you have any further questions please send an email to:  
[2200926@sit.singaporetech.edu.sg](mailto:2200926@sit.singaporetech.edu.sg)

## **PARTICIPANT SIGNING SHEET**

### **PARTICIPANT PLEASE READ CAREFULLY**

I have read the information provided in pages (1-2) of this document carefully and give all the necessary consent to take part in the evaluation. Please sign in the box (to be completed by the participant), that you agree with the above statements and give your consent.

### **To be completed by the PARTICIPANT**

Full Name of the participant:

Contact Email:

Signature:

Date:

## **EVALUATOR CONTACTS**

### **EVALUATORS**

Please contact the evaluators, if you have any concerns regarding the evaluation.

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**END OF DOCUMENT**