A Specialized Degree Planner for UPLB Students

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***Abstract*— This paper introduces a specialized degree planner web application designed for undergraduate students at the University of the Philippines Los Baños (UPLB). The planner aims to help students overcome challenges in following their prescribed curriculum by offering features such as prerequisite identification and unit requirement verification. It utilizes UPLB's course and curriculum database to ensure accuracy and compliance with university rules. A user evaluation with UPLB undergraduates indicated above-average usability, though feedback suggested improvements in instructions and mobile-friendliness. Future work includes refining usability and exploring the planner's impact on student success metrics.**

***Index Terms*— degree planning, study planning, curriculum visualization, curriculum mapping, student information systems**

I. Introduction

A. Background of the Study

A degree program consists of a curriculum of courses laid out in a prescribed order. At the University of the Philippines Los Baños (UPLB), there are recommended plans for each degree program that the students are advised to follow to complete their degrees on time. However, students may not be able to follow their prescribed curriculum exactly due to enrollment challenges, course failures, or a transfer from another degree program. Given the obstacles students face in adhering to a curriculum, degree planners emerge as valuable tools for students to track their progress and plan the next semesters of their academic careers.

A degree planner is a tool that helps students to plan and visualize their coursework. Degree planners can be broadly categorized into two types: specialized degree planners and universal degree planners. Specialized degree planners are designed to be used by a specific university. They provide a structured framework that aligns with the institution's unique academic requirements. These planners often integrate directly with the university's course catalog. Furthermore, specialized degree planners typically offer features that enhance the planning process. Prerequisite identification, unit requirement verification, and course checklists are common examples of these features. These functionalities provide students with real-time feedback on the validity and feasibility of their plans, reducing the likelihood of errors and ensuring that they are on track to graduate on time. Universal degree planners, on the other hand, are designed to work with any degree program at any institution. These planners lack specific features tailored to a particular university but they can be more easily adapted for any degree program for any university. These two types of degree planners can be seen as ends of a spectrum, where the degree of constraints and adaptability provided by the features represents different points along the continuum. The University of Melbourne's My Course Planner is an example of a specialized degree planner. It has a feature called the Plan Checklist where the user sees the university rules that the plan is following or violating. Other universities with specialized degree planners include California Polytechnic State University, University of Nebraska-Lincoln, University of Pittsburgh, etc. In contrast, any software that a student uses to plan their degree program can be labeled as a universal degree planner. For example, a spreadsheet editor can be used as a degree planner by using the grid interface to create a table of courses organized by the semester in which they are to be enrolled. Another example is the use of image editing software where users can draw similar tables or flowcharts to create their own plan.

Degree planners also vary in terms of their usability. Usability is one of the most critical factors in determining a software's effectiveness. It has been defined by different authors and institutions. For Nielsen [1], usability is "a quality attribute that assesses how easy user interfaces are to use." The International Organization for Standardization [2] defined it as the "extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." The usability of a particular software product is measured using usability evaluation and several researchers have come up with different methods of conducting such evaluation. Hu and Chang [3] formulated a methodology using a quantified definition of website usability. Their formula factors in the usability of individual goal-tasks, the appropriateness of the system's navigation mechanisms, and the interface and presentation of the system. Matera et al. [4] gave three criteria for a usable web application: content visibility, ease of content access, and ease of content browsing.

B. Statement of the Problem

There are already various degree planners for different platforms but there is still a need to develop a specialized degree planner for UPLB. UPLB's Student Academic Information System (SAIS) has a degree planner called My Planner under the Academic Planning section. However, the only specialized feature that it possesses is its integration with the course catalog when selecting courses to add. In terms of usability,

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the SAIS degree planner displays the courses in the plan in a list-based interface. Finnley [5] found that list-based interfaces are less efficient, appealing, and comfortable than grid-based interfaces.

Although there is already a preexisting degree planner for UPLB students, the absence of specialized features and poor usability practices create a significant gap in specialized degree planners for UPLB students. Due to this, students are left with three choices: use the SAIS degree planner, work with universal degree planners, or forgo the use of degree planners altogether. Relying on the SAIS planner can hinder strategic course selection, while generic planners offer little guidance on UPLB's unique requirements. Skipping degree planning altogether can lead to missed prerequisites, scheduling conflicts, and potentially extended semesters, affecting academic progress and graduation timelines.

C. Objectives

The general objective of this study is to develop and evaluate a degree planner web application specifically designed for use in UPLB and to evaluate the usability of the application. Specifically, the study aims to:

1) develop a web application for planning, tracking, and visualizing the coursework of UPLB students;
2) implement features that ensure course plans comply with university rules, including prerequisite requirements, unit limitations, and sequencing restrictions;
3) give users the ability to easily generate documents that use information from the planner;
4) assess the overall usability of the application.

D. Significance of the Study

The web application will address the gap in specialized degree planning tools for UPLB students. UPLB's existing degree planner, while integrated with the course catalog, lacks the functionality and usability features necessary to effectively guide students through their academic journeys. By providing features such as prerequisite identification, unit requirement verification, and the employment of usability principles, the planner can help students stay on track to graduate on time.

The development of a specialized degree planner can also complement and strengthen UPLB's academic advising services, providing students with an additional tool to supplement their interactions with academic advisors. This can lead to more efficient and effective advising practices, allowing advisors to focus on in-depth discussions and personalized guidance.

Beyond the immediate impact on UPLB students, the research can contribute to the broader academic community's understanding of the design, implementation, and evaluation of specialized degree planners, potentially leading to the development of more effective and context-specific tools for other universities.

E. Scope and Limitations

The web application can only be used on devices that are compatible with web browsers. The development of the application will not focus on optimizing the application for mobile screens. Additionally, the web application will only focus on undergraduate UPLB students. This study focuses on the initial development and usability of the planner, and a separate, longer-term study would be necessary to fully assess its impact on student success metrics, including grades and graduation rates. Lastly, the reliance of the application on UPLB's existing database means that any error or inconsistency in the database will be inherited by the system.

II. Related Literature

A. Curriculum Visualization

The motivation of early studies on curriculum visualization was for analysis and development of curricula. In 1984, White and Calhoun [6] developed a visual methodology for examining curricula. They used a two-dimensional graph where the horizontal axis describes the continuum of specialized courses to non-specific courses and the vertical axis plots a continuum of visual courses to technical ones. They mapped the 42 elective courses taken by students of the School of Library and Information System of Drexel University. The map showed that the courses in the curriculum are unified. In 1992, King [7] used Q-analysis to analyze the curriculum taken by university scholars of Pennsylvania State University. Q-analysis uses a series of mathematical tools to analyze set systems. It focuses on the "q-connectivity" of elements within a set, where "q" refers to the dimension of the smallest "face" they share. For example, if two students share the course ARTH112H, they are 0-connected. If they also share another course CHEM12H, they become 1-connected. Q-analysis then analyzes how these connections build up to form higher-dimensional faces and reveal the overall structure of the set system. This study demonstrates that mathematical theories can be used to visualize and analyze curricular data.

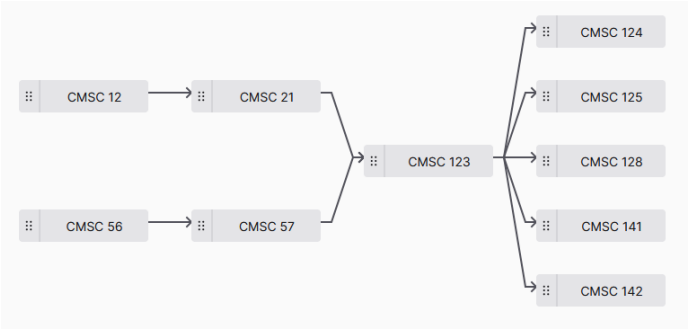


Fig. 1: An example of a graph of courses from the BS Computer Science program.

Graph theory is the study of graphs, which are objects that consist of vertices and edges. Graphs can also be called concept maps or networks. Various papers on the visualization of curricula have leaned on the use of graphs to show the relationships between courses [8] [9] [10] [11] [12] [13]. The directional nature of edges in a graph highlights the prerequisite dependency of courses as seen in Figure 1. This clarifies the sequence in which courses need to be taken by students. The proposed degree planner for UPLB students will

also use graphs to visualize the various curricula. Aldrich [8] utilized graph theory to come up with the Curriculum Prerequisite Network to analyze the undergraduate curriculum of Benedictine University and its Biochemistry and Molecular Biology (BMB) program. The network is a directed graph where the vertices are the courses and the edges represent prerequisite relationships. Using the topological properties of the network, he evaluated how integrated and cohesive are the courses of the curriculum. A well-integrated curriculum has appropriate connections between courses and there is minimal isolation of courses. A curriculum exhibits coherence in two ways: through prerequisite relationships, where foundational skills are learned before building on them in later courses, and through thematically linked courses taken concurrently, where concepts reinforce each other. The author found that the courses of the BMB program are well integrated for subjects that are in the same field of study but there is less integration between the fields. He also found that the undergraduate curriculum of the institution can be more coherent with regards to courses that had no relationships. CurricVis [11] is a curriculum visualization tool that also uses a directed graph to represent the structure of a curriculum. The tool helped faculty in discussing curricula and was also helpful to students in understanding the structure of their degree programs.

The visualization process is not limited to two-dimensional approaches. Sommaruga and Catenazzi [14] employed a three-dimensional approach to visualize all the curricula of the University of Applied Sciences of Southern Switzerland. In the 3D world that they created, each curriculum has a rectangular block and these blocks are divided into areas that represent the semesters. Each area is populated with buildings that represent the courses. The dimensions of the buildings depend on the attributes of the courses that they represent. The authors found that this approach led to intuitive navigation despite having some navigation issues with the software that they used. This approach also produced a system that was easy for users to learn how to use.

The mentioned curriculum visualization studies shed light on curriculum structure and cohesion, but lacked the student-centric focus needed for proactive academic planning. The proposed degree planner fills this gap by leveraging graph theory visualization with university data and user interaction, enabling students to build personalized, feasible course plans within program requirements. It surpasses the analytical limitations of previous works by enabling interactive navigation and proactive visualization of individual academic pathways.

B. Degree Planning Tools

The visualization of curricula can also be used to develop tools to plan the courses to be taken by building on top of the visualization. Nuutinen and Sutinen [12] developed CME2, a tool for creating concept maps for the curricula of the University of Joensuu. The intended purpose of the application was to be a planner and a personal counseling tool by offering recommendations to students based on the courses they have added. Samaranayake et al. [13] used a similar approach to visualize the curricula of the University of Wisconsin-Whitewater in their degree planning application. Directed graphs were used to display prerequisite relationships; the courses are the vertices and the edges denote the relationship. Their application was intended to help students make informed decisions on selecting major and minor courses. Auvinen et al. [10] developed a degree planning and curriculum development tool for Aalto University. They also used a directed graph for the structure of the curriculum but they used the learning outcomes of the courses as nodes instead of the courses. In their applications, the course's learning outcomes are displayed and are connected to other learning outcomes to signify the progression of knowledge in a curriculum. Their paper was inconclusive whether their planner is beneficial to students but they found that the visualization made the students spend more time viewing the courses. Beyond its use as a planning tool, their application was found to help develop a new curriculum for the School of Engineering at their university, again highlighting the value of curriculum visualization.

Despite the number of degree planners that also serve as curriculum visualizers, they do not always need to focus on visualizing curriculum. Ajanovski's [9] approach to his degree planning system is the recommendation system. There still are visual aspects of the software but the objective of the study was to develop a tool that can advise students on which courses to select. The application proposes plans to students based on course dependencies and prerequisites. Similarly, PLAN-BERT [15] is a degree planner that utilizes a recommendation system to help students select courses to take. Like an e-commerce website generating products from the user's cart or basket, PLAN-BERT also considers the courses that students wish to take in the future along with the student's history of continuous enrollment to generate a degree plan. The authors found that their developed system has the potential to be a practical tool in offering virtual guidance to students.

III. Materials and Methods

The proposed study aims to develop a web application of a specialized degree planner for UPLB students.

A. Development Tools

The web application will be written in TypeScript, a free and open-source programming language that adds types to JavaScript. The following technologies were also used.

- *Node.js*: A runtime environment used to build server-side applications using JavaScript.
- *Next.js*: A web development framework that offers an optimized approach in creating applications using React. React is a front-end library used in developing user interfaces. It is built on top of Node.js.
- *Firebase*: A platform that provides several backend services. The application used the authentication and database services.
- *react-grid-layout*: A layout system for React, it provides an interactive grid interface with draggable and resizable components.

B. Data Scraping and Processing

To ensure that the application has all the courses and curricula of UPLB, the data is scraped from UPLB Academic Management Information System (AMIS). The raw data then underwent a cleaning process to remove the attributes that were not needed by the degree planner. Afterwards, the data is formatted into the appropriate structure to fit the needs of the application.

C. Degree Planning Interface

The main feature of the application is the degree planner. The planner starts with an empty interface as seen in Figure 2; the user must click the *New plan* button to begin planning. When clicked, a prompt, as seen in Figure 3, will appear where they can choose the curriculum that will be the base of their plan. The curricula are organized by degree program for an easier search. The user will also be asked to input the year in which their study commenced or will commence.

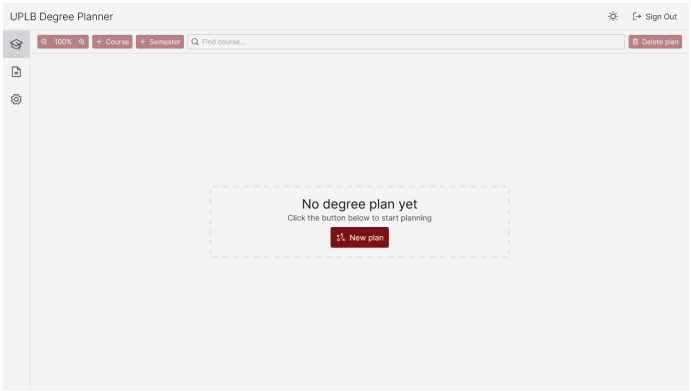


Fig. 2: The planner in an empty state.

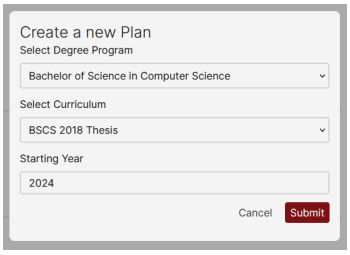


Fig. 3: The prompt asking the user to select a curriculum and the starting year of the curriculum.

Once a curriculum is selected, the planner is shown filled with the courses of the selected curriculum as seen in Figure 4. The planner uses a grid system inspired by the format that some colleges in UPLB use to visualize a curriculum shown in Figure 5. Each column on the grid represents an academic semester. The top of the column shows the semester number and the academic year based on the given input when the plan was created. At the bottom of the column is the number of units per semester, the units for courses like HK and NSTP will be counted separately and will be placed inside a parenthesis. The bottom-most part shows the total number of units present in the planner over the total units needed to complete the selected curriculum.

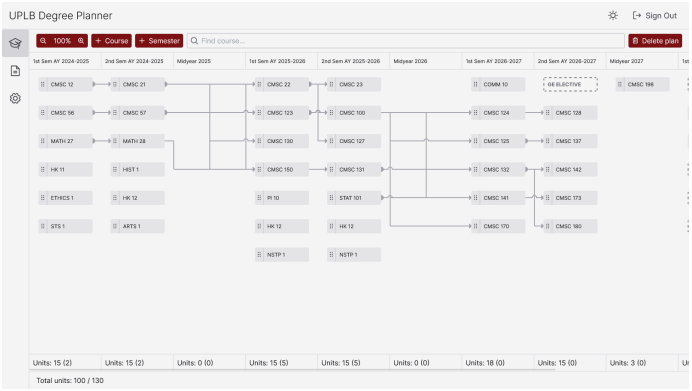


Fig. 4: The planner interface filled with courses from the BS Computer Science General Curriculum.

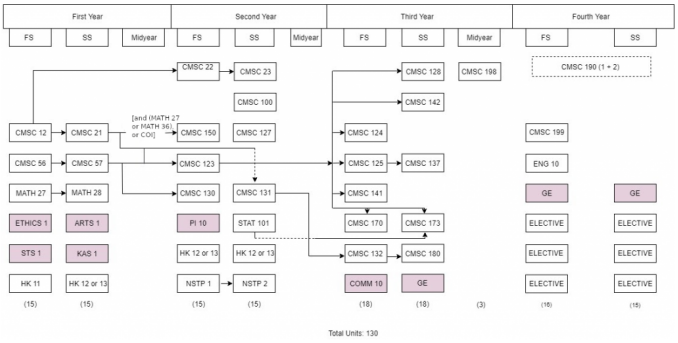
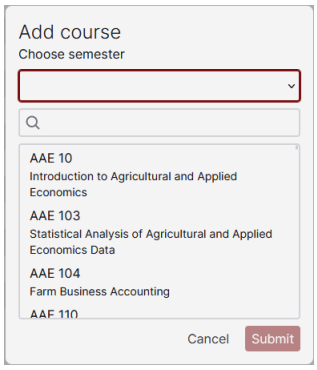


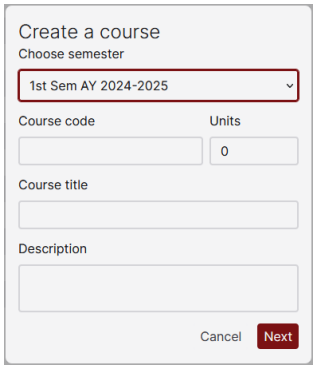
Fig. 5: BS Computer Science flowchart from the Institute of Computer Science.

At the top of the curriculum is the menu bar for various controls over the plan. The first button on the menu bar is the zoom control. It consists of three buttons: the left button zooms out the planner, the right button zooms in, and the middle button that shows the current level of zoom which will reset the zoom to 100% when clicked. The next button is for adding a new course to the planner. The user can choose to add a course from a list of all the courses in UPLB, create a course from scratch by inputting all the course details by themselves, or add a placeholder for a specific type of course. The three methods is shown in Figure 6. The next button is for adding a semester. Adding a semester increases the number of columns in the planner. At the middle of the menu bar is a search bar to look for courses inside the planner. If a search query is typed, courses that do not match the query will turn translucent while courses that match will retain its quality of being opaque so that they stand out. The last button of the menu bar is for deleting the whole plan. Deleting the plan will revert the interface to the empty state

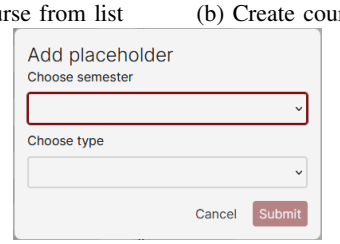
The left part of a course item is its drag handle as signified by the grip dots. The course can be moved either within its own semester or across semesters by using the handle to drag. The main area of a course item can be clicked to reveal a card as seen in Figure 7. It contains the course code, title,



(a) Add course from list



(b) Create course from scratch



(c) Add placeholder course

Fig. 6: The three methods of adding a course to the planner.

number of units, description, and requisites of the selected course. A course can have multiple sets of requisite courses. Each set of requisites can be a prerequisite or corequisite. The planner checks the completion of these requisites. A green highlight means that a requisite is satisfied, a yellow highlight means that a requisite is missing or incorrectly placed, and a gray highlight means that no course in the requisite set is in the plan. The card also has buttons to edit and delete the selected course. Clicking the edit course button brings up a modal similar to the modal when creating a course except it is already filled with the details of the selected course.

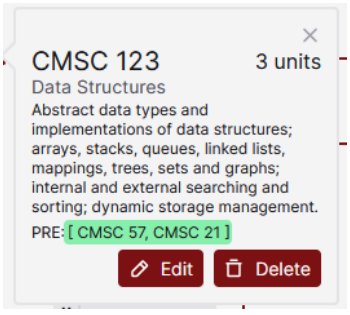


Fig. 7: Course details of CMSC 123

A placeholder course is a course item that doesn't refer to a specific course. There are seven types of courses in the system and each type can be added as a placeholder. The seven types are: Required, GE elective, Cognate, Track, Specialized, Elective, and Major. A placeholder indicates that at the semester in which it is placed, any course of that placeholder type can be taken. The difference in appearance between a placeholder course and an actual course item is shown in 8. When a placeholder is clicked, a modal appears which contains the list of courses that the user may select to replace the said placeholder. The list of courses depends on the curriculum, some curricula have a list of courses under a specific type while some do not. It is also possible to ignore the list and choose from the list of all courses for cases where the curriculum has no list of a particular type. Another use of placeholder courses is to track the different types of courses being added to the plan which will be important when generating a Plan of Study.

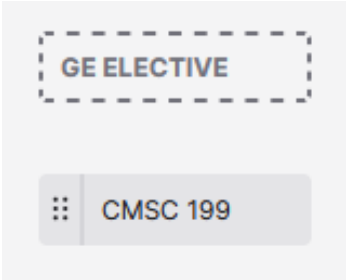
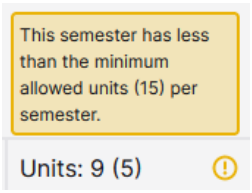
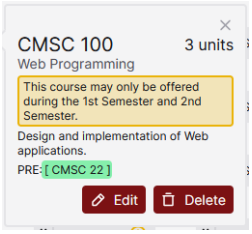


Fig. 8: Difference between a placeholder and an actual course.

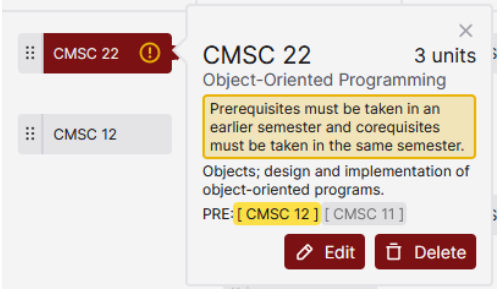
The degree planner uses warnings to help students make sure that their current plan is valid. The three general types of warnings in the planner are for: course requisites, number of units, and which semesters offer a specific course. The warning for course requisites appear on a course item when no course requisites are satisfied. An example for course requisites warning can be seen in 9c as CMSC 22 shows a warning because CMSC 12 should be taken before it. Figures 9a and 9b show examples of the two other warnings.



(a) Units warning



(b) Semesters offered warning



(c) Requisie warning

Fig. 9: Warnings that can be seen in the planner.

The application employs an acyclic directed graph to illustrate prerequisite relationships. The courses are the vertices, while the directed edge (x, y) denotes that course x is a prerequisite of course y. Each course has properties about its location on the grid; the edges are drawn using these properties. Only satisfied prerequisites can have its relationship

visualized. The edges have a circle at that start and an arrowhead at the end to differentiate the ends. For the sake of simplicity, the edges will also be called arrows in this paper. The arrows are drawn using scalable vector graphics (SVG). The arrows are segmented into five parts to make the presentation better and the three middle segments of the arrow can be adjusted by dragging them. An example of a course with prerequisite arrows is shown in 10. The points of intersections of the arrows are identified through calculations from the existing lines. The planner renders ”jumps” to make it easier for users to follow the connections. A sample of a ”jump” can also be seen in 10

Fig. 10: An arrow connecting CMSC 131 and CMSC 132. The arrow jumps through a vertical line that intersects it.

D. Settings

Aside from the planner itself, the application also has a page for updating details and changing settings. The following is the list of currently available settings.

- Plan settings
  - Year started: This will update the starting year shown in the plan.
  - Total units: This will update the total units needed to finish the curriculum.
- Display settings
  - Show course connections: This setting will display arrows that show how courses are related.
  - Animate course connections: Turn this on to animate the path of the arrows when you select a course. This can make it easier to follow the connections between courses.
  - Show arrows for selected course only: If enabled, selecting a course will hide the arrows not connected to the selected course.
- Warning settings
  - Ignore unit warnings: This setting will hide warnings that appear when a semester has too few or too many units.
  - Ignore requisite warnings: This will hide warnings about missing prerequisites for courses.
  - Ignore semesters offered warnings: Enable this setting to hide warnings that a course might not be offered in the semester where it is placed. This is enabled by default since the course data are not entirely accurate regarding this information.

There is also a button to change the appearance of the application, it can be in light mode or dark mode. The button can be found at the top right part of every page. By default, the application is in light mode.

E. Generating Documents

The application offers the ability for users to generate documents related to course requirements by using the data from the degree plan. For example, a GE plan of study form needs the semester in which required and elective GE courses is to be taken. The application can generate the said document by checking the plan for GE courses and getting the semester that they are under to fill out the form. An example of this is shown in 11. The other input boxes in the document for the other details can be manually filled by clicking on them but it is optional. Clicking the Download button at the top of the document downloads a PDF file of it.

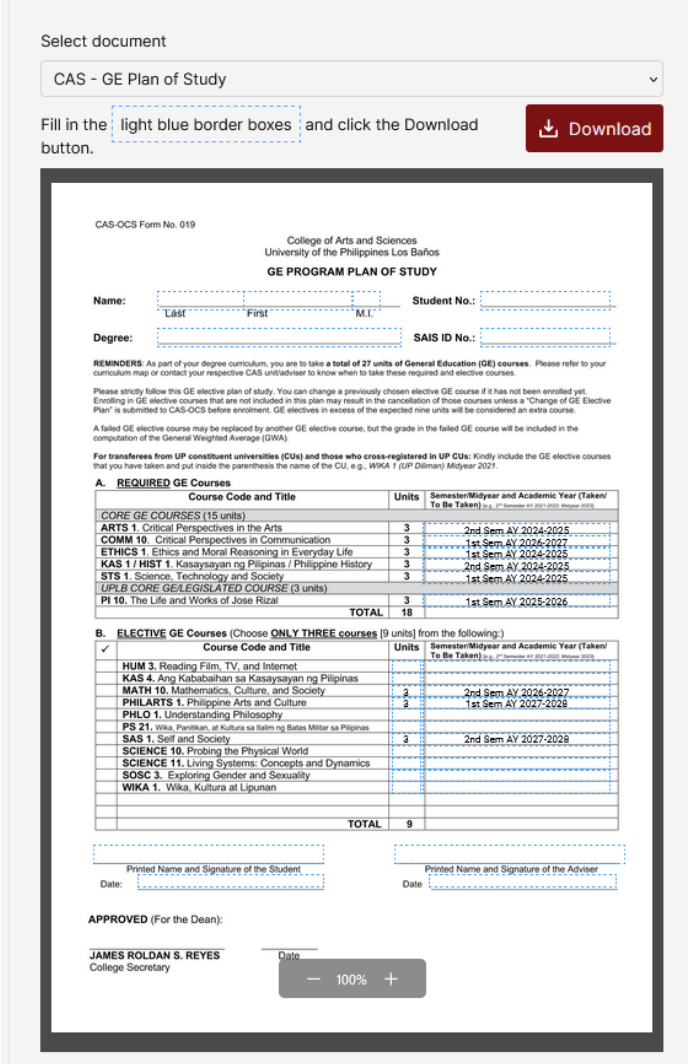


Fig. 11: A GE plan of study generated by the application.

For documents that need other types of courses like Elective, Major, Cognate, etc., the plan uses replaced placeholder courses. As an example, the BS Computer Science program has a Plan of Study form for the students' chosen electives. If the user has replaced Elective-typed placeholder courses with specific courses, they will be added to the form. This can be seen in 12.

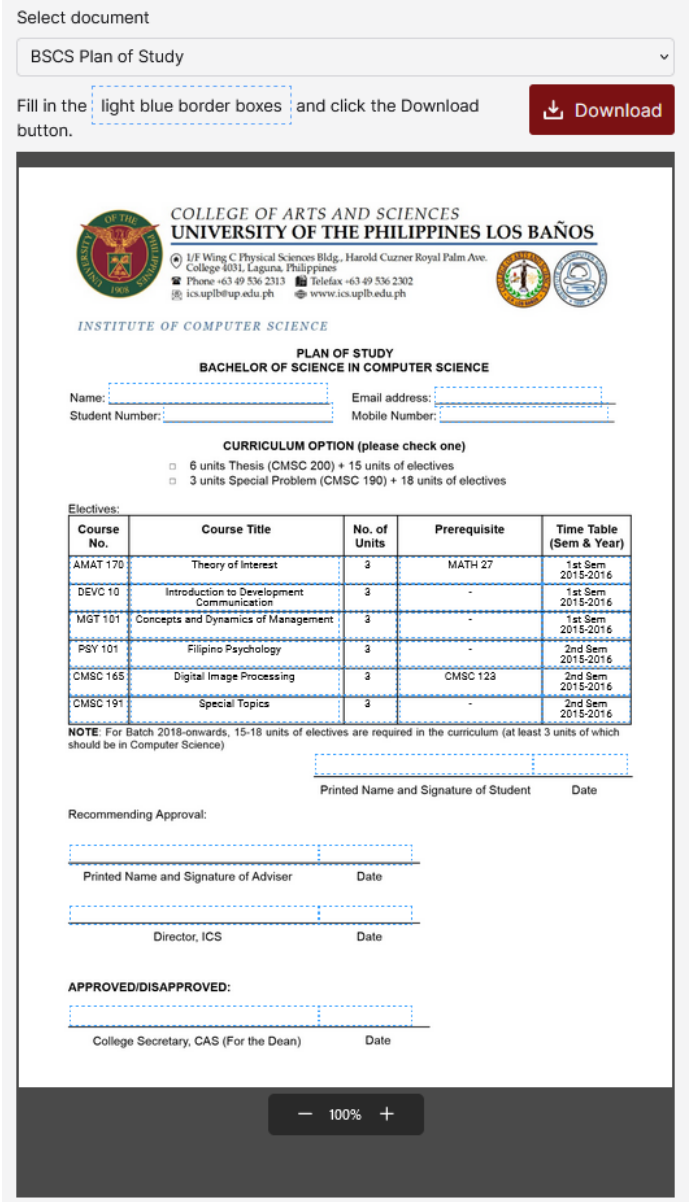


Fig. 12: A BS Computer Science Plan of Study from the application.

F. Authentication

Users can save their plan and settings by signing in. The process of signing in can be done by using Google or GitHub. Aside from the plan and settings, the position of the course connections are also saved in the database. Users that are not willing to sign in will still be able to access their plan through the same browser since it is saved in the browser's local storage.

G. User Evaluation

To assess the usability of the application, a user evaluation was conducted involving undergraduate students from UPLB. The goal was to gather both quantitative and qualitative feedback to understand how effectively the application meets the needs of its users and to identify areas for improvement.

The evaluation process began with the deployment of the application using Vercel's web hosting services. This is done to provide the participants with an easy way to access the application using a web browser. The respondents were then selected through convenience sampling. In total, 10 undergraduates from various degree programs were selected to participate in the study. The respondents were tasked to engage with the application by creating a degree plan that reflected their current academic standing. Additionally, they were tasked with generating a GE plan of study. No specific instructions were provided on how to navigate or use the application.

The System Usability Scale (SUS) was used to measure the usability of the degree planner. SUS is a ten-item scale that provides an overview of the system's perceived usability [16]. It has been demonstrated as an effective and reliable tool for evaluating the usability of a wide range of user interfaces [17].

After the respondents were finished with using the application, they were asked to fill out a questionnaire that included the SUS items. In addition, an open-ended question was included to solicit general comments, suggestions, and any questions the respondents might have regarding the application. This qualitative feedback was added to gain deeper insights into the user experience and identifying specific areas that may require refinement.

IV. Results and Discussion

The user evaluation involved 10 undergraduate students from various degree programs at UPLB. The individual scores can be seen in Table I. The average SUS score was 84.75. According to Lewis [18], the average SUS score is 68 and a score of at least 80 is indicative of an above average user experience. Specifically, using the Sauro-Lewis curved grading scale (CGS), a score of 84.75 would get a grade of "A+".

Resp.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Score
1	5	1	5	1	5	1	5	2	5	1	97.5
2	5	1	5	2	5	1	5	1	5	3	92.5
3	4	1	4	1	4	2	4	1	3	1	82.5
4	5	2	5	1	5	1	5	1	5	1	97.5
5	5	3	5	3	5	1	5	1	5	3	85
6	4	4	2	4	4	2	4	2	2	4	50
7	4	2	4	1	4	2	3	1	5	1	82.5
8	4	2	4	2	4	2	3	2	4	2	72.5
9	4	2	5	1	5	1	5	2	5	1	92.5
10	5	1	4	2	5	1	5	1	5	1	95
					Mean						84.75

TABLE I: Table of individual scores

In the qualitative feedback, the most common responses included the general usefulness of the application and the intuitive design of the interface. The respondents also highlighted the need for more detailed instructions and a mobile-friendly interface.

The high average SUS score and positive feedback on the interface suggest that the UPLB Degree Planner effectively meets its primary usability goals. Users particularly appreciated the customizability it brings to the curriculum they are following. However, the feedback also indicated some usability weaknesses. Some features, like the ability to adjust the course connections, weren't as apparent to some users. The

importance of placeholder courses was also not clear to some users at first.

V. Conclusion and Future Work

The developed web application serves as a specialized degree planner for UPLB students. It addresses the gap in existing planning tools by offering features specifically tailored to UPLB's curricula and student needs. The planner integrates features such as curriculum visualization, prerequisite checking, unit requirement verification, and document generation.

This study contributes to the field of academic planning tools by demonstrating the effectiveness of a curriculum-specific approach. The positive user evaluation, with an average SUS score of 84.75, indicates that the application is above average in usability and meets the needs of its target users.

Immediate improvements will focus on addressing the lack of instructions, creating a mobile-friendly interface, and adding more documents that can be generated. Other planned improvements include features such as the ability to download the plan as an image, mark courses with pass, fail, or specific grades, undo or redo actions, and share a plan using a link or a QR code.

Additional research could also explore the effect of the degree planner on student success metrics, such as grades and on-time graduation rates. The study could collaborate with other UP campuses and universities to investigate the possibility of adapting the application for use in their schools.

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