SmartCents: A Financial Literacy Mobile Application Using Decision Tree Algorithm

Darvin, Christian Elijah DC.
De La Salle University-Dasmarinas
College of Information and Computer Studies
dcd0655@dlsud.edu.ph

Palomares, Xian Angel B.
De La Salle University-Dasmarinas
College of Information and Computer Studies
pxb0696@dlsud.edu.ph

Cariscal, Yuri Anton S.
De La Salle University-Dasmarinas
College of Information and Computer Studies
cys0775@dlsud.edu.ph

ABSTRACT
Financial literacy is the understanding and application of financial knowledge and skills that allow individuals to make informed decisions about managing money, building wealth, and achieving financial well-being. In a world where the global economy is influenced by factors such as inflation, financial crises, and natural disasters, individuals must develop the capability to navigate these challenges. How can individuals affect meaningful changes to enhance their financial well-being and achieve a life characterized by satisfaction and reduced stress? SmartCents is designed to help college students begin their financial literacy journey. A structured, module-based learning mobile application that recommends modules, the student's areas of difficulty, determined through a survey about their financial habits. The Decision Tree model achieved an accuracy score of 93.26% on the test dataset. This accuracy was obtained by training the model with a maximum depth parameter of 5. Further improvement could be achieved by increasing the availability of data for rare classes.

1. INTRODUCTION

1.1 Project Context
With the increasing Philippine Gross Domestic Product (GDP), the country is recovering from the effects of the COVID-19 lockdown. An infographic posted on the official website of the Philippine Statistics Authority (PSA) [14] indicates that the GDP increased by 0.5%, from 5.8% in Q1 2024 to 6.3% in Q2 2024. The main contributors to this growth were construction, wholesale/retail trade, motor vehicle repair, and financial/insurance activities. The Labor Force Survey conducted by the PSA in June 2024 highlighted that the country's employment rate was 96.9%, higher than the rates of 95.5% in June 2023 and 95.9% in May 2024. The youth employment rate [21], which measures the number of working persons aged 15 to 24 years old, increased by 1.3%, suggesting more opportunities for college students to secure part-time or full-time jobs, thereby contributing to the country's economy. The unemployment rate also decreased by 1.4%, from 4.5% to 3.1%. However, fresh college graduates are still facing challenges in securing job positions due to market competition.

As the global economy is affected by various financial assets, inflation, natural disasters, and crises, developing good financial literacy is increasingly important. In a 2021 article published by Esquire Philippines [3], a survey was conducted on how young Filipinos handle their finances. Most respondents were Millennials and Gen-Z. Of the respondents, 60.6% rated themselves three out of five in terms of financial literacy, and only 19.1% rated themselves higher than three. Among Gen-Z respondents, the numbers were even lower: only 8.7% rated themselves a four, and none rated themselves a five. Factors such as unemployment, financial goals, and savings significantly influence the financial literacy of both Gen-Z and Millennials. Among the respondents, 38.3% of Millennials and 82.6% of Gen-Z identified as unemployed. Regarding financial goals, 54.6% of Millennials and 47.8% of Gen-Z respondents are actively pursuing them. In terms of savings, only 4.9% of Millennials manage to save 10,000 pesos per month, while 71.3% of Gen-Z respondents save less than 3,000 pesos monthly. Lusardi (2019) [11] suggests that having a low level of financial literacy is correlated with ineffective spending, financial planning, expensive borrowing, and debt management.

Everyone has to understand the importance of financial literacy in our lives, especially with regard to the data showing that the majority of young individuals lack it. According to Annamaria Lusardi (2019) [18], financial literacy is essential for encouraging saving and building wealth. It also involves employing prudent investment techniques that might return huge returns. Financial literacy is necessary for meeting necessities including handling crises and reducing income shocks, as well as for achieving personal goals. Even in some of the most developed financial markets globally, there remains a severe shortage of financial literacy, which calls for quick action. One of the most important ways to guarantee that young people make wise financial decisions is to empower them with financial literacy. By promoting financial education, young people and adults can attain long-term financial stability and actively contribute to the economic growth of the country.

1.2 Purpose And Description
The project aims to teach the fundamentals of financial literacy to college students through a module-based learning mobile application. This application offers a structured, module-based learning plan designed to help students begin their financial literacy education. It recommends modules based on the student's areas of difficulty, determined through a survey about their financial habits. The primary objective is to equip students with

the knowledge needed to embark on their financial literacy journey and improve their future financial well-being.

1.3 Statement Of the Problem

Financial literacy is essential in meeting an individual's needs and wants, thereby contributing significantly to overall life satisfaction. Despite its importance, there remains a substantial disparity between those who are financially literate and those who are not. Several factors, including financial stress and the insufficient emphasis on financial education among the youth—particularly students—exacerbate this divide. This issue became increasingly pronounced during the COVID-19 pandemic when seven out of ten Filipinos faced challenges related to debt, which impeded their ability to save. The financial strain also affected students, many of whom were forced to discontinue their education due to a lack of financial resources. These circumstances prompt the critical question: how can individuals affect meaningful changes to enhance their financial well-being and achieve a life characterized by satisfaction and reduced stress? In response to these concerns, "SmartCents" seeks to address the issue by providing financial literacy education to the youth, with a particular focus on students, highlighting the importance of financial literacy in everyday life.

1.4 Research Objectives

1.4.1 General Objectives

To develop SmartCents, a structured, module-based financial literacy mobile application specifically designed for college students, that uses the Decision Tree algorithm.

1.4.2 Specific Objectives

- Gather information from online resources such as books, articles, blogs, and journals on the internet that will serve as the contents of each module.
- Identify the essential requirements of the mobile application to meet users' standards by gathering references from existing applications.
- Gather data on the perception of financial literacy from Google's Dataset Search.
- Create a user-friendly interface for the application using Figma and Dribble as design references.
- Create a comprehensive budget tracker using the Flutter framework.
- Assess the student's knowledge level in financial literacy topics using the survey within the application, identify the lowest-rated area, and recommend an appropriate module to improve that rating.
- Use Decision Tree algorithm to determine the most appropriate module for each user based on their knowledge level.
- Create a database to store students' budgets and track their progress using SQLite.
- Perform manual and automated tests to ensure that the mobile application is working as intended.
- Publish the mobile application to the Google Play Store.

1.5 Significance Of the Study

To help students start their financial literacy journey, this study aims to assist them in understanding concepts such as budgeting, saving, and investing through a personalized mobile application. By developing a free and accessible app, we ensure that students can enhance their financial knowledge without the need for a paid subscription.

The following shall be the benefactors of this study:

Students. We provide students with the opportunity to learn financial literacy concepts in a free and accessible manner, equipping students with essential skills for managing finances both now and in the future.

Parents. We encourage parents to actively support children in developing financial literacy and provide resources to teach effective money management skills.

Professors. We support professors by providing insights that allow adjustments to teaching plans based on specific areas where students face challenges in financial literacy

Future Researchers. We establish a foundation for future research to explore the effectiveness of a modular-based course on financial literacy.

1.6 Scope And Limitations

This study will focus solely on implementing a modular-based course in financial literacy. Furthermore, this study will utilize Flutter and its available packages to implement useful features that benefit the user. It will also use a local database to store students' progress and application-related settings.

Since this project is constrained by the limited number of respondents in our survey, which serves as the primary dataset, the findings may not be fully representative of broader trends or applicable to other contexts. The project will be conducted during the first semester of the 2024-2025 school year.

2. REVIEW OF RELATED LITERATURE

This chapter provides a comprehensive review of relevant literature to establish a theoretical and empirical foundation for the present study. It explores key concepts, previous research, and theoretical frameworks that contribute to the understanding of Financial Literacy. The review will cover various perspectives from scholarly works, identifying gaps in the current body of knowledge and highlighting the significance of this research. By examining related studies, this chapter aims to provide a critical analysis of the existing literature and to position the current study within the broader academic discourse.

2.1 Foreign Literature

2.1.1 Unlocking Financial Success: Empowering Higher Ed Students and Developing Financial Literacy Interventions at Scale Proceedings of the Tenth ACM Conference on Learning at Scale.

Greater financial literacy is crucial for young adults in the United States; however, many financial literacy education courses have shown to be less effective than educators and researchers had hoped. Furthermore, many have not been designed around known curricula or learning science ideas, making it difficult for academics to conduct empirical studies. The study conducted interviews with subject matter experts and young adult students to identify the most important learning objectives for a brief course curriculum to improve the financial literacy of US young adults. The findings from this study were combined with content from our open-source textbooks to create the first of several brief online learning interventions for deployment on the large-scale OpenStax Kinetic research infrastructure. The OpenStax research team

continues to focus on large-scale deployment of financial literacy courses. The study established the framework for the themes and hurdles that US young adults encounter in expanding their financial literacy, and we are currently constructing the first intervention to test the impact we can have on participants' financial understanding.

2.1.2 Financial Literacy Around the World: An Overview.

People must be able to make well-informed financial decisions in an increasingly risky and globalized marketplace, but new international research shows that financial illiteracy is widespread, whether financial markets are well-developed, as in Germany, the Netherlands, Sweden, Japan, Italy, New Zealand, and the United States, or when they are rapidly changing, as in Russia. Other common patterns include women being less financially literate than men and being aware of this shortfall; more educated people being more informed, though education is far from a perfect proxy for literacy; ethnic, racial, and regional differences implying that city-dwellers in Russia are better informed than their rural counterparts, while African Americans and Hispanics in the United States are relatively less literate. Furthermore, those who are more financially literate are more likely to plan for retirement. In fact, answering one more financial question correctly is associated with a 3-4 percentage point higher chance of planning for retirement in countries as diverse as Germany, the United States, Japan, and Sweden; in the Netherlands, it increases planning by 10 percentage points. Finally, we use instrumental variables to show that these estimates likely underestimate the benefits of financial literacy on retirement planning. To summarize, financial knowledge is crucial for retirement security all around the world.

2.1.3 Financial literacy and the need for financial education: evidence and implications.

Throughout their lifetime, individuals today are more responsible for their finances than ever before, and with life expectancies rising, pension and social welfare systems are being strained, in which many countries, employer-sponsored defined benefit (DB) pension plans are swiftly giving way to private defined contribution (DC) plans, shifting the responsibility for retirement saving and investing from employers to employees and with this context, it is important to understand how financially knowledgeable people are and to what extent their knowledge of finance affects their financial decision-making. An essential indicator of people's ability to make financial decisions is their level of financial literacy, in which the Organization for Economic Co-operation and Development (OECD) aptly defines financial literacy as not only the knowledge and understanding of financial concepts and risks but also the skills, and motivation, and confidence to apply such knowledge and understanding to make effective decisions across a range of financial contexts, to improve the financial well-being of individuals and society, and to enable participation in economic life. The Big Three questions that were designed to measure financial literacy go a long way in identifying aggregate differences in financial knowledge and highlighting vulnerabilities within populations and across topics of interest, thereby facilitating the development of tailored programs. Many such programs to provide financial education in schools and colleges, workplaces, and the larger community have taken existing evidence into account to create rigorous solutions, and it is important to continue making strides in promoting financial literacy, by achieving scale and efficiency in future programs as well.

2.1.4 The importance of financial literacy and its impact on financial well-being.

The research is about the effects of financial education in school and the workplace on the importance of financial literacy for the macroeconomy which pertains to how financial inclusion and financial literacy can promote the use of basic financial instruments, such as bank accounts also covering financial decision making in the context of complex instruments, such as mortgages, reverse mortgages, and crypto assets. The research proved that financial literacy is low and often inadequate for making the types of financial decisions that are required today, and financial literacy is particularly low among already vulnerable groups which is what matters because it helps people make savvy financial decisions, including being less influenced by framing, better understand information that is provided to them, better understand the workings of insurance, and being more comfortable using basic financial instruments improving one's financial wellbeing.

2.2 Local Literatures

2.2.1 Financial Literacy, A Priority – VP Leni Robredo

The National Economic Development Authority has an article posted online that states the importance of enhancing the financial competence of the Filipino people. It points out the reality that most would rather spend and save money as a habit that has to be followed with sparing little money to save. Although this may seem very simple for some people, most of them have problems making out their paychecks while balancing their usual bills and dues. In the aspect of community development, Vice President Leni Robredo believes that financial literacy is a part of the social pillars in bringing people towards the process of being efficient in order to become self-reliant. In an interview with Global Dominion, she said that one of the duties of the OVP is to make citizens and let them have a say in political issues and to push for economic self-sufficiency. The OVP has noted this and has seen these aspects of local vendors getting better in regard to the management of their cash flows and it expects that this will continue. It means that there are more opportunities to increase the public's awareness of the importance of being financially literate in the age of numerous online platforms. These platforms create a chance to produce material and work on beneficial generations in the future. Good financial management solidifies the base of every decision each Filipino will make hence influencing society development.

2.2.2 Financial Literacy for every Juan

The Governor of Bangko Sentral ng Pilipinas has declared that the number of Filipino households who have bank accounts has gone up notably and this is a positive development in the financial sector. But, despite this growth, there is the problem of financial illiteracy among Filipinos that can be inferred from low results in financial literacy tests. This is a problem, particularly in light of the growing role of the financing life cycle with a focus on the retirement stage. For this kind of problem, financial literacy programs may be utilized in order to explain to Filipinos how they can put up with funds, the best methods to invest their money as well as utilize it in the correct manner. Education in financial literacy is defined as the availability of information that enables ordinary people to make sound financial decisions that would create wealth. This needs a contribution from the government, private entities, and all individuals to ensure that everyone is given a chance to access financial products.

2.2.3 Bo Sanchez (Life Stories of Financial Literacy Advocates 4)

Bo Sanchez a lay Catholic evangelist in the Philippines is popularly known as the 'preacher in blue jeans' today; he is well known and has been awarded various awards such as TOYM (Ten Most Outstanding Young Men), Serviam Award, for Catholic Mass Media and Golden Gavel Award from Toastmasters. It was also later in life while preaching that Bo's path to accumulating financial wealth commenced. Unlike most of his peers, he instead dedicated his efforts to evangelizing and spreading the word of God. He had a slow process of experiencing financial literacy beginning with the basic form of saving. Bo's works include books, shows, talks, and many others, and everyone who got to know him got to know about the importance of financial literacy. Teaching others how his teachings affected them in a positive manner is something Miles loves to do hence his commitment to advocating for sound financial practices. For instance, Bo told a story of an interaction he once had with a Feast member who thanked him for the expansion of his business from mere distribution to one supplying over a hundred outlets. Some of these he credited to Bo's input in the formation of various streams of passive income such as having ten rental units.

2.2.4 Bringing about a more financially free future through financial literacy

Financial literacy is essential for the Philippines' economic growth. However, many Filipinos lack basic financial knowledge. To address this, more inclusive financial education programs are needed. These programs can help people make informed financial decisions and protect their money. The Sun Life Foundation is committed to improving financial literacy in the Philippines. They offer community-based programs that teach people practical money management skills. By empowering communities to become self-sufficient, the Foundation aims to create a brighter future for Filipinos.

2.3 Foreign Studies

2.3.1 Determinants of the Financial Literacy among College Students in Malaysia

The purpose of this study is to find out the Factors That Affect Financial Literacy Among University Students In Malaysia. The data for this study were obtained by way of the Self Completion Questionnaire and the appropriate sampling technique. Out of 200 distributed questionnaires, only a total of 105 questionnaires were turned in and these are total, complete and valid. Therefore, Pearson Correlation analysis and multiple regression tables were employed to determine the correlation coefficients of various factors of financial literacy. Empirical evidence confirms that money attitude education is related to changes in the score of financial literacy, and no correlation between the scores of financial socialization agents concerning the specified criterion of financial literacy. The purpose of the current study is therefore important in the sense that it will help us establish how the identified independent variables affect young adult literacy. In an attempt to enhance the literacy level of the university learners some of the factors may be sought to change.

2.3.2 Financial Literacy: How Prepared are College Students for their Financial Futures?

This paper compares students' financial literacy and its applicability in the assessment of individual financial status. The college students contacted a total of 617 and out of them only 365 completed the survey. Respondents were asked to indicate their level of financial literacy, interest, perceived importance of the topic, family members' influences, areas of interest, preferred mode of learning financial literacy, and the appropriate grade level at school that financial literacy should be taught. These results suggest that college students in our survey display a rather poor level of financial knowledge. We also emphasize an essential disconnect college students consider financial literacy as very crucial while their interest in the same is far less noticeable. It is for this reason that we should strongly recommend that financial literacy become compulsory at the college level. We find that exposure experienced at home has the most negative effect on financial position according to the results of our regression analysis. This is in agreement with the findings from the survey whereby students place family involvement as the most crucial factor when it comes to the understanding of personal finance.

2.3.3 The role of learning motivation on financial knowledge among Vietnamese Students.

Employing survey data from 730 undergraduates in Vietnam as the sample, the study finds that learning motivation and several factors such as self-efficacy, finance learning value, and accomplishment goals correlate with the student's performance in their financial literacy test. In addition, these associations are conditionalized by student characteristics, with the academic year, type of university, parents' education, and studying math in school activities during high school having the most influential effect. The findings bear several significant implications for policymakers, researchers, and educators: Examination of motivation and its integration into the overall concept of financial literacy education and intervention programs; and the moderating effect of individual characteristics on motivation and financial literacy.

2.3.4 Financially Sustainable Future, are Tertiary Students Ready?

Consumer literacy is highly correlated with the SDGs because it has the ability to create a positive change in people's lives and in the economy to decrease poverty and improve well-being; Promoting financial inclusion, which contributes to SDG 1 and SDG 8 as it gives the population the tools necessary for engaging with the economy and benefiting from economic growth. This research aimed at assessing the level of financial literacy among Malaysian university students whereby it adopted t-test independents to compare the students' financial literacy on demographic characteristics, academic discipline, program level, and financial management courses attended and finally, the PLS-SEM to analyze the relationship of the above factors with students' financial literacy. This research also provided evidence of the fact that students can grasp better their financial management courses and thus are better financially literate. Other goals can only be achieved through the promotion of financial education and strengthening students with the necessary skills in the same field.

2.3.5 Financial Literacy among university students in eight European countries

This study analyzed the level of financial literacy among university students in Estonia, Germany, Italy, Netherlands, Poland, Romania, the Russian Federation, and Turkey, in which the purpose of the study was to determine the level of financial literacy among university students and to find out the relationship between financial knowledge and demographic characteristics of students. An online survey instrument was used to collect data with 409 fully completed questionnaires accepted for analysis and logistic regression was used to analyze the impact of the demographic characteristics on financial literacy in which the overall mean of correct answers for the survey was 72.2%. This result represents a medium level of financial literacy in personal finance. Results indicate that male students, business major students, PhD students, those who live in a rental house, those whose parents have high-level income, those who get advice on financial matters from their friends, those who took financial courses before, those who get financial information about financial issues from university education, and students from Poland are more knowledgeable on personal finance in which more financial courses should be provided in university education programs, which could help more students handle their finances better and improve their financial wellbeing. Taking into consideration that in recent years, environmental and technological influences on financial literacy may be more important than parental influence.

2.4 Algorithms and Its Rules

2.4.1 Merge Sort Algorithm

This study utilizes the Merge Sort algorithm to sort the daily expenses data in the budget tracker feature of the SmartCents mobile application and display it in a tabular format within the downloadable weekly report. A study by Ali et al. (2018) explains that Merge Sort is a Divide-and-Conquer algorithm that systematically divides a list into smaller sub-lists, sorts these sub-lists, and then merges them to form a sorted array. Initially, the input list is recursively divided into single-element sub-lists, which are inherently sorted. The merge process then combines these sorted sublists pair by pair, comparing elements and placing them in the correct order in a new list. This merging process continues until one completely sorted list is achieved. The running time complexity of Merge Sort is O(n log n) because it involves two main steps: dividing the list and merging. The divide phase splits the list into two halves at each level, resulting in log n levels of recursion. The merge phase processes all n elements at each level to combine the smaller sublists into a sorted list. Together, these steps yield a total time complexity of O(n) work per level across log n levels, resulting in O(n log n). In the context of this study, since each expense falls into one of only five predefined categories (Food and Drinks, Health and Wellness, Transportation, Academic Related, Miscellaneous), the Merge Sort algorithm is applied to sort the expenses in descending order. This approach of sorting the expenses gives users a clear picture of where their money is going and enables them to identify the areas where spending is highest.

Merge Sort Algorithm Pseudocode

```
1: function MERGE_SORT(arr)
2:     if length(arr) ≤ 1 then
3:         return arr
4:     end if
5:     middle ← length(arr) // 2
6:     left ← MERGE_SORT(arr[0  TO  middle - 1])
7:     right ← MERGE_SORT(arr[middle  TO END])
8:     return MERGE(left, right)
9: end function

10: function MERGE(left, right)
11:     result ← [ ]
12:     i ← 0
13:     j ← 0
14:     while i < length(left)  and  j < length(right) do
15:         if left[i] ≤ right[j] then
16:             APPEND(result, left[i])
17:             i ← i + 1
18:         else
19:             APPEND(result, right[j])
20:             j ← j + 1
21:         end if
22:     end while
23:     EXTEND(result, left[i:])
24:     EXTEND(result, right[j:])
25:     return result
26: end function
```

Figure 1. Merge Sort Algorithm Pseudocode

The Merge sort is a divide-and-conquer algorithm that recursively splits an array into halves until each subarray has one element or less, then merges these subarrays in sorted order using a helper function that combines two sorted arrays into one, maintaining sorted order.

2.4.2 Fractional Knapsack Algorithm

This study utilizes the Fractional Knapsack Problem to allocate a budget proportionally across different categories based on their assigned weights. The integration of this approach into our financial literacy application ensures that the user's weekly budget is distributed optimally, prioritizing categories with higher importance based on user-defined weights. According to a study by Kanagala (2016), the Knapsack Problem is a combinatorial optimization problem that aims to determine which of a number of potential solutions is the best. A thief in this situation is carrying a knapsack with a limited weight capacity, (M). Each of the n items that are shown to the thief has a weight (W) and a corresponding profit (P_i). The goal is to determine what the thief should take in order to maximize profit while staying under the weight limit of the knapsack. A variant of this is the Fractional Knapsack Problem, in which the thief is allowed to take fractions of the items, in contrast to the 0/1 knapsack. The thief is allowed to carry a fraction (x_i) of each item, where ($0 < xi < 1$). Each item can be divided into smaller sections. The objective is to maximize the overall profit while carrying the knapsack with a combination of items so that the total weight does not exceed the knapsack's capacity, (M) [18]. The running time complexity of Fractional Knapsack Problem is O(n log n) because it needs to sort the items based on their profit-to-weight ratio, followed by a linear pass to select the items that fit within the knapsack's capacity.

As specified in the study "Analyzing Greedy Approach for Fractional Knapsack Problems" [17], the solution aims at achieving an "optimum solution" by maximizing profit while at the same time ensuring that the capacity of the knapsack is not surpassed. The Greedy approach uses a technique that chooses only the items that have a maximum profit per weight so that each step taken is the best step as far as the optimum solution is

concerned. As a result, procedures for refining prior generated solutions are decreased, and the computational scale is reduced. Unlike the 0/1 knapsack problem where items are either selected or ignored altogether, this problem provides for the portioning of items; this way, more refinements are made based on the priority of categories. It means that an item can be taken partially in the knapsack and this in a way optimizes the knapsack to the maximum possible content and at the same time the maximum possible profit. It has also been observed at the end of the study that the proposed strategy of selecting items with the largest profit-weight ratio achieves the maximum profit all the time and hence one can conclude that the solution found here is indeed Optimal. Apart from increasing efficiency, it provides a clear and effective strategy for addressing a vast number of tasks and issues arising in practice with resource allocation at its core.

Fractional Knapsack Problem Pseudocode

Input: List of items with values $v[i]$ and weights $w[i]$, knapsack capacity W
Output: Maximum value that can be obtained, V

Sort items by value-to-weight ratio $v[i]/w[i]$ in descending order
Initialize $V \leftarrow 0$ and $remaining\_capacity \leftarrow W$
for each item i in sorted list **do**
  if $remaining\_capacity \geq w[i]$ **then**
    Add full item to the knapsack: $V \leftarrow V + v[i]$
    $remaining\_capacity \leftarrow remaining\_capacity - w[i]$
  else
    Add fraction of item to the knapsack:
    $V \leftarrow V + (remaining\_capacity/w[i]) \cdot v[i]$
    Break
  end if
end for
Return V

Figure 2. Fractional Knapsack Algorithm Pseudocode

The fractional knapsack algorithm maximizes the total profit of items in a knapsack by first sorting items by their profit-to-weight ratio in descending order, then iteratively adding either full items or fractions of items to the knapsack until the capacity is filled or all items are considered, updating the total profit and remaining capacity at each step.

2.4.3 Decision Tree Algorithm

The Decision Tree Algorithm is a widely used supervised learning technique in machine learning, known for its ability to perform both classification and regression tasks. This algorithm represents data hierarchically, using a tree structure composed of nodes and branches, where each node signifies a decision based on an attribute, and each branch represents the potential outcomes of the decision. Starting at the root node, the algorithm splits the data recursively based on the best attributes, measured using criteria like entropy, information gain, or the Gini index. The process continues until reaching a stopping condition, such as achieving pure subsets or meeting a predefined depth. In the context of the study, the Decision Tree algorithm is used to recommend appropriate financial literacy modules based on the user's self-assessment of statements in a survey about their financial habits, where ratings range from 5 (always) to 1 (never). By analyzing the user's ratings for various topics, such as Financial Planning and Budget and Savings, the Decision Tree algorithm splits the data into decision nodes that progressively narrow down to recommended modules. For instance, if a user struggles with financial planning and rates, it low, the algorithm may recommend a module about financial planning. This method allows the app to provide personalized and relevant course suggestions, making it easier for users to improve in areas they find difficult, based on their financial habits and learning needs.

Figure 3. Visualization of the Decision Tree

The decision tree starts at the root node with the feature Financial Planning ≤ 3.5, which splits the dataset into two branches. If the condition is true, the left branch is followed, further splitting on Budget and Saving ≤ 3.5; otherwise, the right branch is followed, splitting again on the same feature. Each node displays the Gini index (a measure of impurity), the proportion of samples (indicated by "samples"), and the class distribution (shown in the "value" array). The process continues until reaching leaf nodes, which represent the final classification based on the feature splits.

3. METHODOLOGY

3.1 Research Design

This study adopts a quantitative research design, characterized by a descriptive and developmental approach. The main purpose of this study is to document and quantify the results and conclusions of numerical data and assess the respondents' level of knowledge regarding financial literacy around Bacoor. The descriptive aspect of this research entails an endeavor to give a realistic picture of the contemporary state of financial literacy measuring it to define what aspects people are most likely to have the gaps in, and to reveal the factors of demographic character that define the level of financial literacy in the area. The developmental component aims to examine changes and trends in financial literacy over time. This entails a look at how different variables including age, education, and income, affect financial literacy. By studying these developments, the research will provide insights into the progression and potential future directions of financial literacy in Bacoor.

3.2 Participants

The study's participants were college students living in different barangays in Bacoor City, Cavite. They were most often at De La Salle University - Dasmariñas and ranged from 18 to 24 years old, around ages 21–22 is the peak age of most people in the dataset. There are 82.2% non-working students and 17.8% working students. By including diverse representation from various barangays, and different universities, we had more representation of our focus.

3.3 Instruments and Materials

In this study, the researchers used a survey as the main tool to gather the data. The objective of this study is to collect the respondents' self-ratings of their financial literacy. The survey includes a set of questions, which, answering them, can assess their knowledge of finance and financial management including budgeting and saving, Invesment and budget allocation. To guarantee the validity of the study's measures of financial literacy, content validity was adopted whereby the surveys had well-developed questions that captured all financial literacy dimensions. The researchers also minimized sources of sampling bias and error where applicable including administering clear instructions and maintaining a stable environment for the survey while assuring anonymity of participants in taking the survey.

3.4 Data Collection Procedures

The proponents conducted an online quantitative survey using Google Forms. The target respondents for the study were college students residing in Bacoor City, Cavite, aged 18 to 24, with an interest in financial literacy. The survey began on November 11, 2024, and concluded on December 6, 2024. On the starting date, the researchers uploaded a Facebook post inviting potential respondents and directly messaged students within the scope of the study. Prior to this, on November 9, 2024, the DLSU-D Computer Science Program Council shared a Facebook post encouraging Information Technology and Computer Science students at De La Salle University - Dasmariñas to participate in different surveys, including the survey of this study. The survey was officially closed on December 6, 2024, with a total of 46 respondents. To ensure the ethical handling of data, the survey emphasizes compliance with the Data Privacy Act of 2012 (Republic Act No. 10173), which safeguards the lawful and secure processing of personal information. Participants are then asked to provide their consent by selecting "Yes," affirming their agreement to participate in the study under these conditions. In addition, only the group members have the access to view and edit the survey on Google Forms.

3.5 Data Analysis

The collected data were mostly nominal, reflecting respondents' self-assessments of various financial habits. Responses ranged from 5, indicating "always," to 1, indicating "never." The researchers utilized Python libraries such as NumPy, Pandas, Matplotlib, and Seaborn for data cleaning and visualization. Since the dataset primarily consisted of nominal data and demographic information, tests for normality were not conducted, and no outliers were identified. The researchers ensured that all the universities mentioned in the survey were verified as existing organizations.

4. RESULTS

4.1 Introduction to the Results

This chapter presents an overview of how the statistical analysis was done, especially on the t-test on the financial literacy score of working and non-working students. When comparing the financial literacy of working and non-working students the difference was found to be insignificant using the results of t-tests. This means that, in the sample under analysis, there is no significant effect of employment status on financial literacy. The differences detected between the two groups were small or marginal therefore the hypothesis that employment status may not be a strong determinant of financial literacy could be supported.

4.2 Presentation of Data

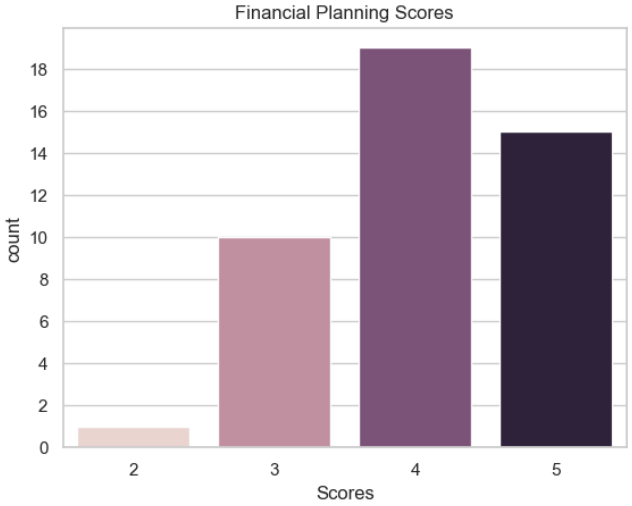

Figure 4. Count plot of the Financial Planning Scores

The count plot shows the distribution of average scores from respondents on the topic of Financial Planning. Most respondents rated their knowledge as a 4 (with the highest count), followed by a smaller group rating it as a 5, while fewer respondents rated it as a 3. Only one respondent rated their knowledge as a 2.

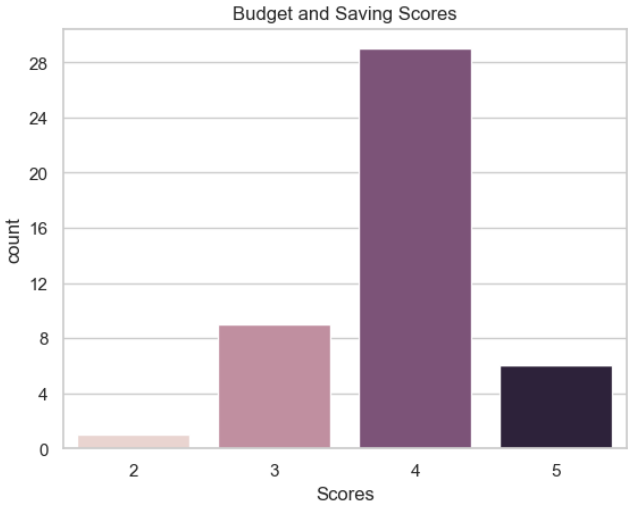

Figure 5. Count plot of the Budget and Saving Scores

The count plot shows the distribution of average scores from respondents on the topic of Budget and Saving. Most respondents rated their knowledge as a 4 (with the highest count), followed by a smaller group rating it as a 3, while fewer respondents rated it as a 5. Only one respondent rated their knowledge as a 2.

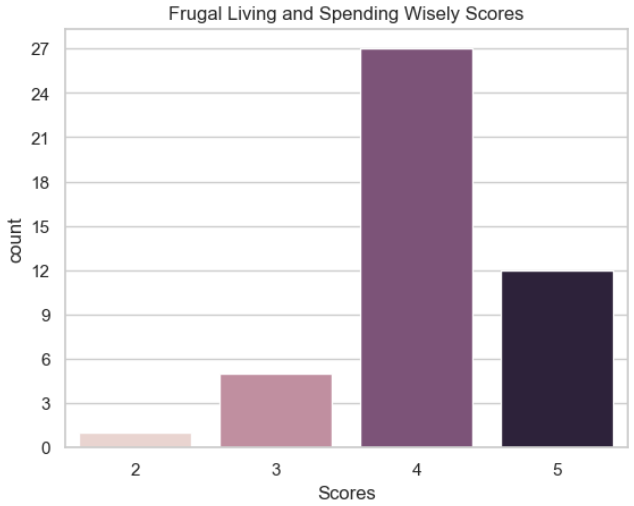

Figure 6. Count plot of the Frugal Living and Spending Wisely Scores

The count plot shows the distribution of average scores from respondents on the topic of Frugal Living and Spending Wisely. Most respondents rated their knowledge as a 4 (with the highest count), followed by a smaller group rating it as a 5, while fewer respondents rated it as a 3. Only one respondent rated their knowledge as a 2.

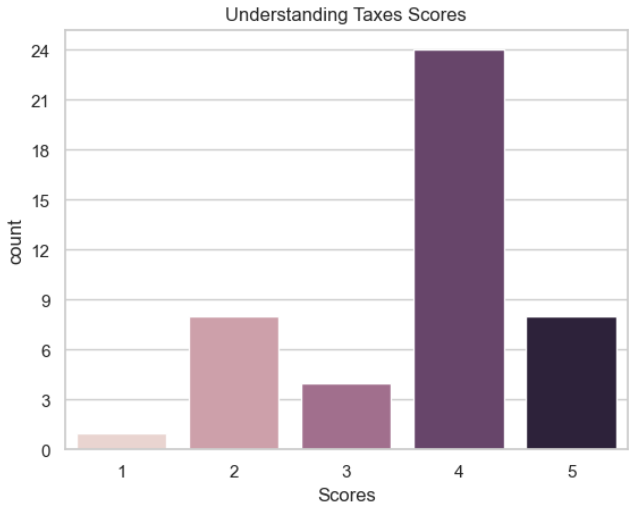

Figure 7. Count plot of the Understanding Taxes Scores

The count plot shows the distribution of average scores from respondents on the topic of Understanding Taxes. Most respondents rated their knowledge as a 4 (with the highest count), followed by a smaller group rating it as a 2, 3, or 5, while very few respondents rated it as a 1.

Figure 8. Count plot of the Debt Management Scores

The count plot shows the distribution of average scores from respondents on the topic of Debt Management. Most respondents rated their knowledge as a 4 (with the highest count), followed by a smaller group rating it as a 3, while fewer respondents rated it as a 5. Only one respondent rated their knowledge as a 2.

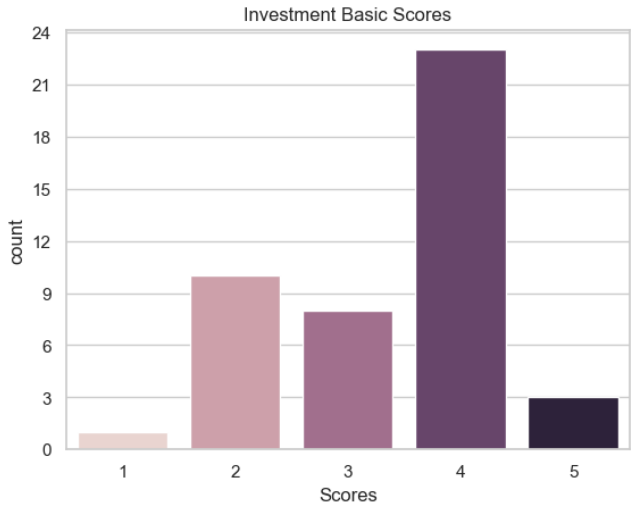

Figure 9. Count plot of the Investment Basic Scores

The count plot shows the distribution of average scores from respondents on the topic of Investment Basic. Most respondents rated their knowledge as a 4 (with the highest count), followed by a smaller group rating it as a 2 or 3, while fewer respondents rated it as a 5. Only one respondent rated their knowledge as a 1.

Figure 10. Mean score comparison for working and non-working students

The bar plot shows the comparison of the average financial literacy topic scores between the working and non-working students. Each bar group represents a specific financial literacy category, such as Financial Planning, Budgeting and Saving, and Debt Management. For most categories, working students tend to score slightly higher than non-working students. However, in the Budget and Saving category, the non-working students have a slightly higher score than the working students.

4.3 Descriptive Statistics

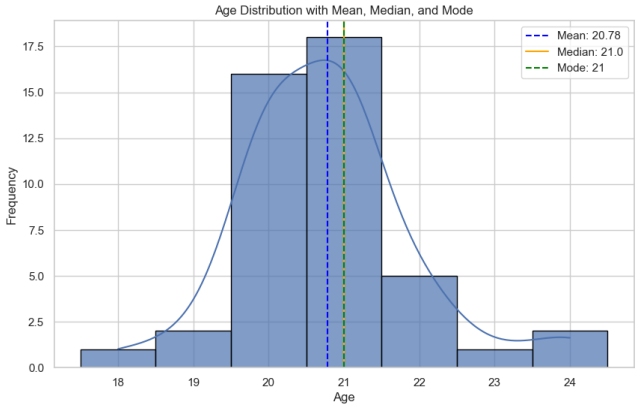

Figure 11. Histogram of the Age Distribution with Mean, Median, Mode

The histogram shows the age distribution of the respondents, along with the mean, median, and mode of the dataset. The distribution is slightly skewed to the right, as the mean is slightly less than the median. The histogram peaks around age 21, suggesting it is the most common age in the dataset.

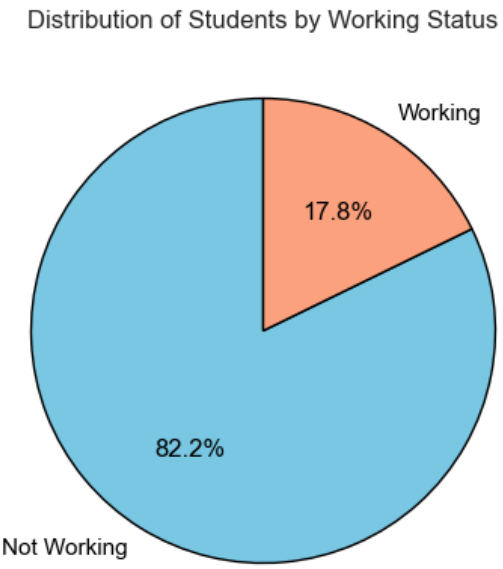

Figure 12. Pie chart of the distribution of students by working status

The pie chart shows the distribution of students based on their employment status. Of the total, 82.2% are not working, while 17.8% are employed. This indicates that the majority of students in the dataset are not employed.

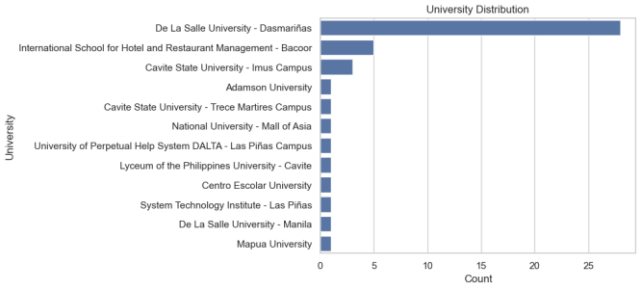

Figure 13. Bar plot of the University Distribution

The bar plot shows the distribution of universities where the respondents study. Most of the respondents are from De La Salle University - Dasmariñas, with a total of 28 respondents. The International School for Hotel and Restaurant Management follows with 5 respondents, and Cavite State University – Imus Campus has 3 respondents. Other universities are represented by 1 respondent each.

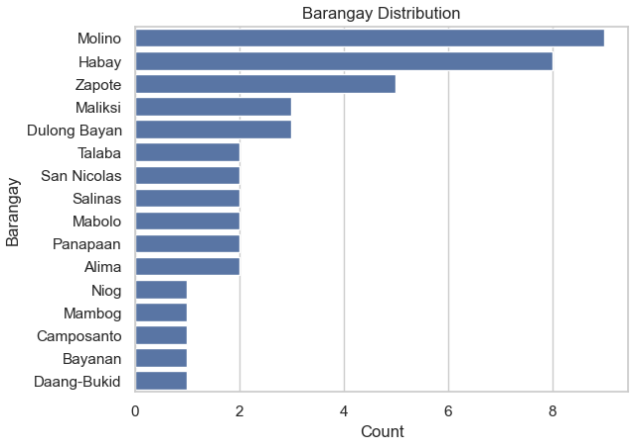

Figure 14. Bar plot of the Barangay Distribution

The bar plot illustrates the distribution of barangays where the respondents reside. Most respondents live in Molino, totaling 9. Habay follows with 8 respondents, and Zapote has 5 respondents. The remaining barangays are represented by 3, 2, or 1 respondent each.

	precision	recall	f1-score	support
Budget & Savings, Debt Management	0.678571	1.000000	0.808511	19.000000
Budget & Savings, Debt Management, Financial Planning	1.000000	0.944828	0.971631	290.000000
Budget & Savings, Debt Management, Frugal Living and Spending Wisely	1.000000	1.000000	1.000000	27.000000
Budget & Savings, Debt Management, Investment Basics	1.000000	1.000000	1.000000	62.000000
Budget & Savings, Debt Management, Understanding Taxes	0.000000	0.000000	0.000000	9.000000
Budget & Savings, Financial Planning	0.795455	1.000000	0.886076	35.000000
Budget & Savings, Financial Planning, Frugal Living and Spending Wisely	0.926606	1.000000	0.961905	202.000000
Budget & Savings, Financial Planning, Investment Basics	1.000000	1.000000	1.000000	76.000000
Budget & Savings, Financial Planning, Understanding Taxes	0.000000	0.000000	0.000000	9.000000
Budget & Savings, Frugal Living and Spending Wisely	0.000000	0.000000	0.000000	3.000000
Budget & Savings, Frugal Living and Spending Wisely, Investment Basics	0.000000	0.000000	0.000000	14.000000
Budget & Savings, Frugal Living and Spending Wisely, Understanding Taxes	0.000000	0.000000	0.000000	1.000000
Budget & Savings, Investment Basics	0.790698	1.000000	0.883117	34.000000
Budget & Savings, Investment Basics, Understanding Taxes	0.891304	1.000000	0.942529	41.000000
Budget & Savings, Understanding Taxes	0.923077	1.000000	0.960000	12.000000
Debt Management, Financial Planning	0.720588	1.000000	0.837607	49.000000
Debt Management, Financial Planning, Frugal Living and Spending Wisely	1.000000	1.000000	1.000000	66.000000
Debt Management, Financial Planning, Investment Basics	1.000000	1.000000	1.000000	87.000000
Debt Management, Financial Planning, Understanding Taxes	0.000000	0.000000	0.000000	19.000000
Debt Management, Frugal Living and Spending Wisely	0.000000	0.000000	0.000000	10.000000
Debt Management, Frugal Living and Spending Wisely, Investment Basics	0.000000	0.000000	0.000000	15.000000
Debt Management, Frugal Living and Spending Wisely, Understanding Taxes	0.000000	0.000000	0.000000	4.000000
Debt Management, Investment Basics	0.868421	1.000000	0.929577	66.000000
Debt Management, Investment Basics, Understanding Taxes	0.945205	1.000000	0.971831	1173.000000
Debt Management, Understanding Taxes	0.933333	1.000000	0.965517	56.000000
Financial Planning, Frugal Living and Spending Wisely	0.919355	1.000000	0.957983	57.000000
Financial Planning, Frugal Living and Spending Wisely, Investment Basics	0.000000	0.000000	0.000000	22.000000
Financial Planning, Frugal Living and Spending Wisely, Understanding Taxes	0.000000	0.000000	0.000000	5.000000
Financial Planning, Investment Basics	0.868687	1.000000	0.929730	86.000000
Financial Planning, Investment Basics, Understanding Taxes	0.785714	1.000000	0.880000	33.000000
Financial Planning, Understanding Taxes	0.000000	0.000000	0.000000	35.000000
Frugal Living and Spending Wisely, Investment Basics	0.000000	0.000000	0.000000	11.000000
Frugal Living and Spending Wisely, Investment Basics, Understanding Taxes	0.000000	0.000000	0.000000	4.000000
Frugal Living and Spending Wisely, Understanding Taxes	0.000000	0.000000	0.000000	4.000000
Investment Basics, Understanding Taxes	0.924528	1.000000	0.960784	49.000000
accuracy	0.932588	0.932588	0.932588	0.932588
macro avg	0.513473	0.569852	0.538480	2685.000000
weighted avg	0.879840	0.932588	0.904188	2685.000000

Figure 15. Classification Report of the Decision Tree Algorithm

The Python function used for labeling the recommended modules returns a list of three module names. The outputs are interpreted as individual labels or categories. This can cause the classifier to treat each combination of modules as a unique label (e.g., "Budget & Savings, Financial Planning" versus "Budget & Savings, Debt Management"), resulting in a large number of unique classes. The support column reveals that some combinations have very few samples, which leads to poor performance metrics for those classes. This issue arises because the model struggles to generalize with insufficient data for rare classes.

```
X = df.drop(columns=["Recommended_Course"])
y = df["Recommended_Course"]

X_train, X_test, y_train, y_test = train_test_split(
    X, y, test_size=0.3, random_state=42, stratify=y
)

decision_tree = DecisionTreeClassifier(
    max_depth=5
)
decision_tree.fit(X_train, y_train)

# Predict on the test set
y_pred = decision_tree.predict(X_test)

# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print(f"Accuracy of the Decision Tree model: {accuracy:.4f}")
```

```
✓ 0.0s
Accuracy of the Decision Tree model: 0.9326
```

Figure 16. Accuracy of the Decision Tree Algorithm

The Decision Tree model achieved an accuracy score of 93.26% on the test dataset. This accuracy was obtained by training the model with a maximum depth parameter of 5. However, while this is a good score, accuracy alone may not provide a full picture of the model's performance, especially if the dataset is imbalanced. Other metrics, such as precision, recall, or F1-score, might also be considered to evaluate the model comprehensively.

4.4 Inferential Statistics

To analyze differences between working and non-working students, independent samples t-tests (Welch's t-test) were conducted for each self-assessment category. This test was chosen due to the assumption of unequal variances between the two groups. The t-test results indicate that positive t-statistic values reflect higher scores for working students, while negative values suggest slightly higher scores for non-working students. However, none of the p-values are ≤ 0.05, indicating that the differences between working and non-working students across all financial literacy categories are not statistically significant. Although small effect sizes were observed in some categories, such as Financial Planning and Investment Basics, the differences remain minimal and hold little practical significance.

Table 1. T-tests for working and non-working students

The table compares working and non-working students across six financial education categories, showing no statistically significant differences (all $p > 0.05$) and mostly negligible or small effect sizes, indicating minimal practical differences between the groups.

Category	**t-Statistic**	**p-Value**	Effect Size (Cohen's d**)**
Financial Planning	1.08	0.309	Small
Budget and Saving	-0.05	0.958	Negligible
Frugal Living and Spending Wisely	1.13	0.287	Small

Understanding Taxes	0.87	0.396	Small
Debt Management	0.36	0.727	Negligible
Investment Basic	1.79	0.099	Small

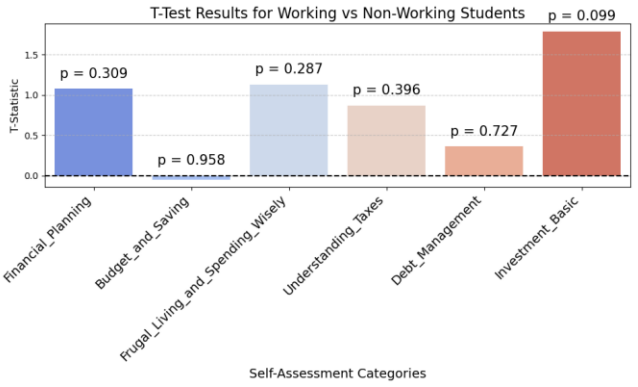

Figure 17. Bar plot of the T-test for working and non-working students

The bar plot shows the results of independent samples t-tests (Welch's t-tests) conducted to compare the self-assessment scores of working and non-working students across six financial literacy categories. Each bar represents the t-statistic for a specific category, and the corresponding p-values are displayed above the bars. The plot shows no strong evidence to suggest that working students outperform non-working students (or vice versa) in financial literacy across these categories. Small effect sizes indicate minor trends, but these differences do not carry statistical or practical significance.

4.5 Comparison with Previous Research

This study differs from prior research on financial literacy by introducing a novel approach that calculates financial literacy scores as the average of responses to three statements, each rated on a scale from 1 (Never) to 5 (Always), and by integrating computer science algorithms such as Merge Sort, the Fractional Knapsack Problem, and Decision Tree. In contrast, other studies, such as those influenced by Annamaria Lusardi's financial literacy questionnaire, often utilize a more robust quiz-like format. These questionnaires assess foundational financial knowledge through questions about key concepts, including interest rate calculations, the impact of inflation on purchasing power, and the principles of risk diversification. In addition, a study conducted by Bradford et al. (2023) [7] uses a utility-value theory to boost motivation by having students relate lesson topics to their lives, while a control group summarizes the lesson. Pre- and post-intervention quizzes will measure knowledge gains, focusing on improving outcomes for students with lower confidence or prior performance.

5. DISCUSSION AND CONCLUSION

Financial literacy is vital for an individual's well-being, although it is still uneven across the groups, particularly learners. Reasons for such a situation include poverty and poor financial literacy or lack of financial literacy. This gap somehow widened during the COVID-19 pandemic; many Filipinos found themselves in debt and/or students stop pursuing education due to the financial crises. Each of these challenges may be addressed by "SmartCents" in their essence that attempts to provide financial education for youth, describing it as relevant to today's living.

5.1 Summary of Key Findings

Most of the respondents demonstrate a moderate to good level of financial literacy. By analyzing the count plots, the majority of respondents scored a 4 across various financial literacy topics, indicating a strong understanding, particularly in Financial Planning, Budget and Saving, Frugal Living and Spending Wisely, and Debt Management. While some topics, such as Understanding Taxes and Investment Basics, show a slightly more varied distribution, the prevalence of scores at 4 reflects a generally consistent level of competency in financial literacy among the respondents. The t-tests show that there are no statistically significant differences in financial literacy scores between working and non-working students. The observed differences are small or negligible, suggesting that employment status does not strongly impact financial literacy scores in your sample.

5.2 Interpretation of Results

The results of the study provide valuable insights into the financial literacy levels of working and non-working students across various self-assessment categories. The findings reveal no statistically significant differences between the two groups in any of the financial literacy topics, as evidenced by p-values exceeding the 0.05 threshold. While some categories, such as Financial Planning and Investment Basics, exhibit small effect sizes, the overall differences remain minimal and do not suggest practical significance. These results address the research questions and hypotheses by showing that employment status (working vs. non-working) does not play a major role in determining financial literacy levels. This challenges the initial hypothesis that working students might exhibit higher financial literacy due to practical exposure to financial management tasks such as budgeting, saving, and managing expenses. When compared to existing literature, the findings align with studies suggesting that financial literacy is more influenced by educational programs, socio-economic background, and personal interest rather than employment status alone. For example, previous research highlights the importance of financial education in formal curricula as a stronger determinant of financial literacy outcomes. However, the results deviate from studies that argue working students have a financial advantage due to real-life application of financial concepts, which was not observed in this study. The findings underscore the need for targeted financial literacy programs that can enhance understanding across all student groups, regardless of employment status. These results suggest that practical exposure alone may not guarantee financial literacy improvements, highlighting the importance of integrating financial education into academic and extracurricular activities.

5.3 Implications of Findings

The findings contribute to existing financial literacy literature by challenging theories that emphasize practical work experience as a key driver of financial knowledge, reinforcing instead the importance of formal education, socio-economic factors, and personal engagement. Practically, the results suggest that financial literacy programs should target both working and non-working students equally, as neither group demonstrates a significant advantage. Universities and organizations can implement workshops focusing on critical areas such as Budgeting, Debt Management, and Investment Basics to equip students with practical financial skills. From a policy perspective, integrating financial literacy into academic curricula as a mandatory component could ensure equal access for all students. Additionally, initiatives like workplace-based financial training

for student employees and community programs for non-working students could help bridge gaps, fostering a financially capable generation prepared to make informed decisions.

5.4 Limitations of the Study

This study is limited by the fact that the majority of respondents were college students from De La Salle University - Dasmariñas, which may not fully capture the financial literacy levels of students from other universities. Consequently, the findings may not be representative of broader trends or applicable to different contexts. The sample size is also limited, and the data collection methods could be improved by incorporating a robust financial literacy questionnaire that provides a more comprehensive insight into college students' financial literacy.

5.5 Recommendations for Future Research

Future research should explore financial literacy across a more diverse sample of students from different universities to capture broader trends and ensure findings are more widely applicable. Expanding the sample size would also enhance the representativeness of the results. Researchers could adopt Annamaria Lusardi's financial literacy questionnaire, as it offers a more detailed and structured approach to assessing financial knowledge, potentially providing more robust insights. Additionally, future studies could investigate factors such as students' personal finance management practices, access to financial education, and the impact of real-life financial experiences on literacy. This would provide a more comprehensive understanding of the variables influencing financial literacy.

5.6 Conclusions

Most respondents generally demonstrated moderate to good financial literacy, with the majority scoring a 4 on topics such as Financial Planning, Budgeting, Frugal Living, and Debt Management. Although Understanding Taxes and Investment Basics showed slightly less variability, the overall results indicate consistent competency. More importantly, the researchers found no statistically significant difference in financial literacy scores between working and non-working students, suggesting that employment status has minimal impact on the financial literacy of the sample. An important implication of this research is the wide impact of financial literacy in teaching students how to combat financial problems and become independent This study offers a personalized strategy to address students' knowledge gaps through structured learning modules provided by SmartCents, a free and accessible mobile application. The findings are important for supporting students, parents, professors, and future researchers with practical tools and insights for improving financial education. This research does tackle financial literacy by providing students the ability to make educated decisions about money which will secure long-term financial wellness regardless of employment status.

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