CHAPTER I

INTRODUCTION

Overview of the Current State of Technology

Students', specifically those assigned with programming courses cannot easily grasp in taking off on the basics of understanding programming concepts. Though a lot of these student's may say that it is a challenging task, the process of understanding the basics is the foundation to become skillful in a specific programming platform. A programming instructors' intervention provided to the students covers programming concept topics, of which, is difficult to be managed when a class has a size of 40 students. Students taking computer programming courses very often come with various backgrounds and ability levels (Wang, F.L., Wong, T.-L., 2008). Since the level of the students' skill is not easily identified, various rubrics are developed, which may possibly measure the skill set of the student through a scoring method, but can never measure the programming skill level.

Classroom management is a great challenge for both the instructor and students, especially when teaching programming courses, because the interaction and monitoring of learning are so wide.

A Learning Management System (LMS), a software application or web-based technology, manages classroom management by planning, implementing, and evaluating a specific learning process. It serves as a fundamental tool in e-learning environments and typically consists of two main components: a server that handles core functionalities and a user interface (UI) used by instructors, students, and administrators. An LMS allows instructors to create and deliver educational content, track student engagement, and assess student performance. It also provides interactive features for

students, such as threaded discussions, video conferencing, and discussion forums (Kirvan and Brush, 2023).

When integrated with conventional AI, an LMS can further enhance the learning experience by offering personalized learning paths, automated grading, and predictive analytics to identify at-risk students and tailor interventions accordingly. AI can also enhance the interactivity and responsiveness of the LMS, making it a more effective tool for both teaching and learning.

Computer Aided Instruction (CAI) is one of the vast innovating technologies needed to support classroom intervention by a student to develop a skill, especially in the aspect of one's programming skills to become adept on a programming platform. Research has demonstrated the effectiveness of CAI technology in teaching introductory programming courses (Anderson & Skwarecki, 1986), allowing instructors to use it as a supplementary teaching tool during classroom interventions.

In the current state of programming education, students often face challenges in mastering programming concepts and developing proficiency in coding. One major issue is the use of disparate resources for programming assistance, leading to confusion and inconsistency in learning materials. Students may struggle to find comprehensive and cohesive resources that cover all the necessary programming concepts and fundamentals.

Despite their effectiveness, learning environments often fail to engage users and end up underutilized. Many studies show that gamification of learning environments can enhance learners' motivation to use learning environments (Lavoué et al., 2018). Various fields such as business, health, and education use gamification, which involves applying game concepts in non-gaming contexts. Teaching programming languages has long been challenging, with many students struggling to grasp programming logic. We employ gamification to motivate students, enhance engagement, and promote practice and idea

exchange as a solution to this challenge. Elshiekh and Butgerit (2017) developed a paper on "Using Gamification to Teach Students Programming Concepts," where they reviewed empirical studies that have used gamification to aid computer science students in learning and improving coding skills, presenting the outcomes of this approach at the university level.

At present, students enrolled in programming courses often encounter difficulties in grasping fundamental programming concepts. These challenges may stem from the diver5se backgrounds and skill levels of students, making it challenging for instructors to effectively manage classroom interactions and provide individualized support. Looking at the scenario in the academics on this present situation, the availability of instructors outside of scheduled class times may be limited, further hindering students' ability to seek assistance with programming queries.

Research has shown that CAI technology, incorporating features like Natural Language Processing (NLP) and chatbot functionality, can enhance the effectiveness of teaching introductory programming courses. By providing students with a learning tool that offers interactive tutorials, code examples, and real-time feedback, CAI can supplement traditional classroom instruction and cater to the diverse learning needs of students (Asad M.M, et. al , 2021).

In developing the computer-aided instruction (CAI) system for students learning programming, the integration of conversational artificial intelligence (AI) stands out as a powerful approach. While different technologies like gamification and learning management systems (LMS) were considered for enhancing learning experiences, the researcher opted for CAI using conversational AI due to its unique benefits.

Conversational AI brings a personalized, interactive element to the learning process, allowing for real-time, natural language interactions between students and the system. This technology can simulate human-like tutoring, providing immediate

feedback, answering queries, and guiding students through complex programming concepts. Unlike traditional LMSs, which excel in structured content delivery and assessment, conversational AI offers a more dynamic and responsive learning environment.

While gamification focuses on boosting engagement and motivation through game elements, conversational AI can incorporate these elements while maintaining a conversational interface that adapts to individual learning needs. This creates a more holistic and engaging learning experience, combining the motivational aspects of gamification with the structured, adaptive support of an LMS.

By choosing conversational AI, the CAI system can provide a more interactive, engaging, and personalized learning experience, effectively addressing the challenges of teaching programming and helping students develop their skills more efficiently. This approach leverages the strengths of both gamification and LMS, offering a comprehensive solution for computer science education.

Statement of the Problems

1. Different programming concepts and fundamental resources are being used to assist students on their programming queries.

2. Insufficient specific examples on code structures pertaining to programming fundamentals.

3. Limited time of instructors to provide assistance to students' queries outside of classroom.

4. Difficulties in accessing supplementary learning resources for computer programming courses.

Objectives of the Study

General Objectives

To develop a Computer Aided Instruction for learning Computer Programming using Conversational Artificial Intelligence.

Specific Objectives

1. To provide students with a learning tool that integrates the various programming concepts and principles for developing computer programming skills.

2. To develop a library of specific examples on code structures and exercises to enhance the learning process.

3. To provide an online and onsite console that will be accessible to students anytime and anywhere they may be.

4. To provide an assessment module for tracking the learning progress of the student.

Theoretical and Conceptual Framework
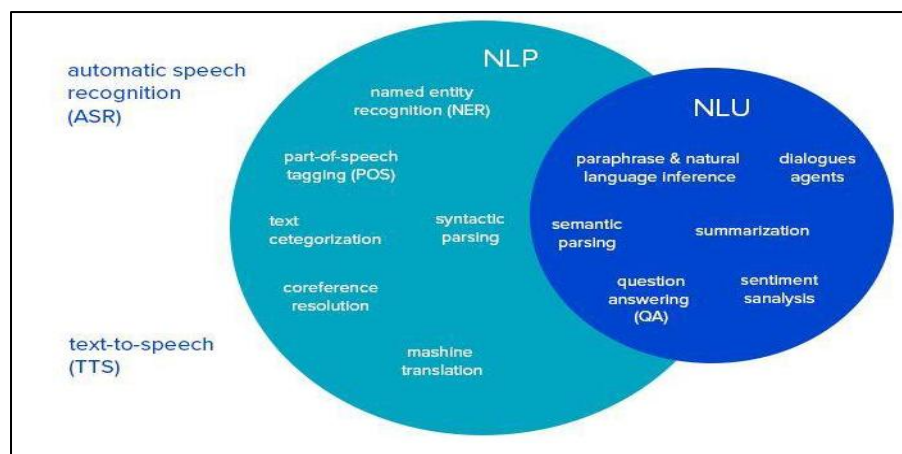
Theoretical Framework of the Study

Figure 1. Theoretical Framework of the Study

The utilization of Natural Language Processing (NLP) services and application programming interfaces (APIs) serves as a theoretical framework for the development of conversational programs, including chatbots. It is designed to accommodate organizations of all sizes, from the smallest to the largest. Smart Bots have the capacity to increase client satisfaction through the utilization of NLP to enhance customer support services. This is the central argument.

The research on the efficacy of novel instruments for teaching and learning has not yet been done in depth, pertaining to the dynamic nature and advancement of new technologies. By establishing educational technologies as objects within their social usages for teaching and learning and furnishing a syntax of practice that outlines particular techno-pedagogical competencies, faculty members are empowered to place practitioners' labor at the core of a community of practice's syntactic parsing. (Grossman, 2011; Lave, 1991).

In addition to possessing a versatile and continuously developing repertoire of technological proficiencies, instructors must also possess the capacity to discern appropriate techno-pedagogical approaches that effectively captivate students with the subject matter. The educational progress of students is profoundly impacted by media literacy; therefore, it is vital to foster the ability to analyze media consumption critically.

Instructors, in addition to institutions, need to recognize and communicate the real-world effects that arise from the convergence of technology and competencies. Additionally, they must comprehend and articulate the ways in which technological resources and strategies can effectively captivate students and augment their educational experience. (Moore & Readence, 1984).

The framework for Technological Pedagogical Content Knowledge is the result of collaborative efforts among scholars and researchers aiming to define and elucidate the

competencies arising from the intersection of pedagogy and technology. The adoption of new and interactive technologies in education necessitates proficiency in both technical and pedagogical aspects for their effective utilization. As per the National Educational Technology Standards, faculty members should possess the skills to design digital assessments, creatively model digital work, advocate for digital citizenship, and inspire student learning.
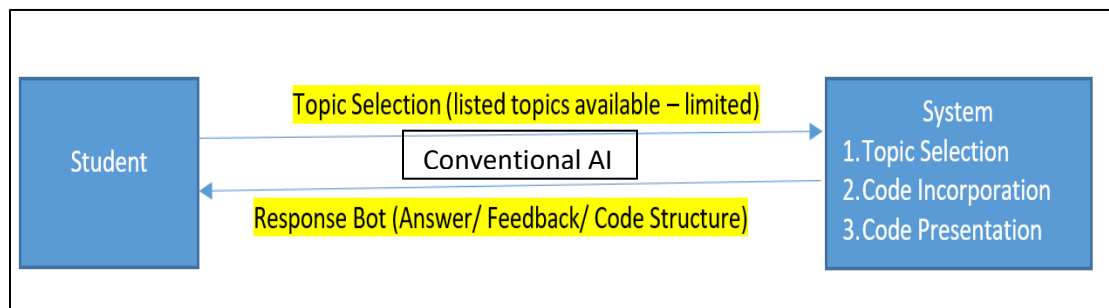
Conceptual Framework of the Study

Figure 2. Student Intervention to System and Receiving Response

The system entails the student as the main user of the system. Upon access to the system, a topic selection is available for the student to be able to interact with the system. With this, a query is sent to the system wherein it will be process and deliver an output through a response bot.
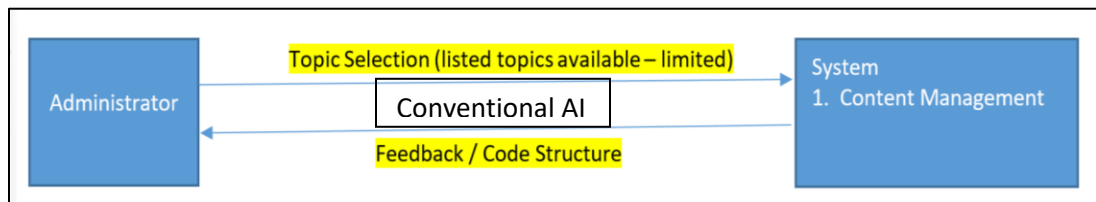

Figure 3.Encoding and Update of Content

In the area of administering and managing the system, it will be able to upload data and other information as co-related with a programming platform concept that involved program structure discussions and other related topics.

Topic Selection

The skill of crafting a compelling research topic is crucial. While an instructor might provide a designated topic, more frequently, they expect you to choose a topic of (umflint.edu).

Topic selection is available in this study to allow the end-user to select an expertise track in teaching programming.

Code Incorporation

The term "data" refers to the input and output data used in a process or algorithm. Understanding data, control structures, and design patterns is crucial, particularly for presenting program coding in a way that aligns with the chosen programming scenario.

Code Presentation

The presentation of code refers to showing the user the program structure from the basics of a platform, leading to either an intermediate or advanced coding presentation. This will assist the student in learning how to initially start off with their programming skills.

Content Management

There are diverse content management systems designed to cater to the requirements of users across various industries. Content management encompasses a wide range of activities, including program administration, platform discussions, and the organization of a website's digital assets. It also involves the storage of enterprise documents, such as branding guidelines, business plans, emails, and more. (vasont.com).

Content management systems contribute to the efficient, organized, and secure handling of digital content, offering numerous benefits for businesses, organizations, and individuals.

Algorithm: Word2Vec

Word2Vec is a two-layer neural network designed for text processing. It takes a text corpus as input and generates a set of vectors, serving as feature vectors for words within that corpus. Although Word2Vec may not qualify as a deep neural network, it transforms text into a numerical representation that deep neural networks can (deeplearning4j.org).

In the realm of computer-aided instruction utilizing conversational artificial intelligence (CAI), Word2Vec emerges as a valuable tool.

Word2Vec operates as a two-layer neural network that processes text, taking a text corpus related to computer-aided instruction as its input. The output of Word2Vec consists of vectors, which essentially serve as feature vectors representing words within the given corpus. Despite not being classified as a deep neural network, Word2Vec's strength lies in its ability to convert text into a numerical form. This numerical representation is crucial for facilitating the comprehension of text by deep neural networks, thereby enhancing the effectiveness of conversational artificial intelligence in the context of computer-aided instruction. By transforming textual information into a format that deep nets can interpret, Word2Vec plays a pivotal role in bridging the gap between traditional text data and the sophisticated processing capabilities of conversational AI systems.
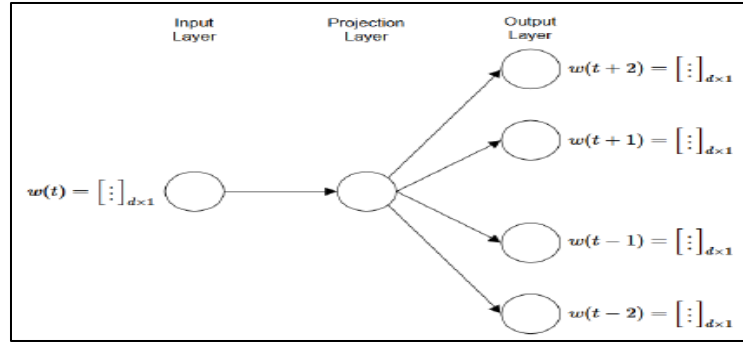
Figure 4. Word2Vec Algorithmic Representation

Word2Vec's utility goes beyond parsing sentences in natural language. It is equally effective when applied to diverse domains such as genes, code, likes, playlists, social media graphs, and other verbal or symbolic sequences where patterns can be identified. Like genes, code, likes, and playlists, words are discrete states, and the search for transitional probabilities between these states reveals a high likelihood of concurrence.

In essence, Word2Vec proves being adaptable to various types of data, treating words as discrete entities much like other mentioned datasets and exploring the probabilities of their co-occurrence.

The primary goal and effectiveness of Word2Vec relies in grouping similar word vectors together within a vector space, achieved through mathematical detection of similarities.

Word2Vec generates distributed numerical representations of word features, capturing aspects like the context of individual words, all without requiring human intervention. With ample data, usage examples, and diverse contexts, Word2Vec can make highly accurate predictions about the meaning of a word based on its historical appearances. These predictions enable the establishment of associations between words and the clustering of documents, facilitating topic classification.
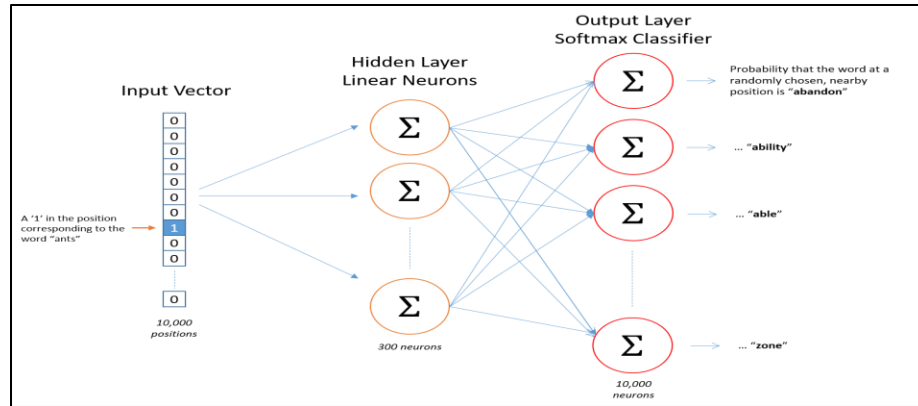
Figure 5. Word2Vec Algorithmic Visualization

The outcome of the Word2Vec neural network is a vocabulary where each item is associated with a vector. This vector can be input into a deep-learning network or directly queried to identify relationships between words.

As the algorithm is implemented in the chat feature of the system to be developed, it will have a data bank wherein keywords resides that would be used in the evaluation and processing of the entered keywords or phrases by the user. As the input is received by the system, it then evaluates to be able to provide an appropriate response to the user. For newly encountered terminologies that are not yet available in the databank, the system has a trainer feature that will allow to grasp the unidentified keyword and it will be captured by the system. This new terminologies will then go through a review process and will be evaluated by the Administrator if the entered keyword is a related keyword to be placed in the data bank.

In the development of a computer-aided instruction system for learning computer programming using conversational artificial intelligence, the Word2Vec algorithm plays a pivotal role in enhancing various aspects of the system. Primarily, it addresses the objective of integrating diverse programming concepts and principles. Word2Vec transforms student queries into vector representations, enabling the conversational AI to understand the context and semantics accurately. This allows the AI to provide precise

and relevant explanations, making the learning of programming concepts more effective. Word2Vec also contributes significantly to the development of a library of specific code examples and exercises. By analyzing and categorizing programming problems and solutions, it helps recommend relevant examples and exercises tailored to each student's queries and learning stage, thus enhancing the learning process.

While Word2Vec does not directly affect system accessibility, it ensures that the conversational AI delivers consistent, high-quality responses across both online and offline.

Operational Definition of Terms

Computer Aided Instruction (CAI). CAI, as used in this study, refers to an educational system or software application that employs conversational artificial intelligence (AI) to facilitate learning and skill development in computer programming. It includes features such as interactive tutorials, code examples, and real-time feedback to support students in mastering programming concepts.

Conversational Artificial Intelligence. In this context, conversational artificial intelligence denotes the technology integrated into the CAI system, enabling natural language interactions between users and the educational platform. It encompasses algorithms and methodologies like Natural Language Processing (NLP) and chatbot functionality to comprehend user inquiries and deliver relevant responses in a conversational manner.

Instructional Materials. Instructional materials refer to the educational resources utilized to facilitate teaching and learning processes.

Console. This term refers to the interface or platform provided to students for accessing the CAI system.

Code Presentation. Code presentation refers to the manner in which programming code is displayed and presented to students within the CAI system.

Content Management. Content management encompasses the processes and strategies employed to create, organize, and maintain educational content within the CAI system.

Scope and Limitations of the Study

The development limitations solely focus on the requirement for a specific programming platform, necessitating a deliberate process to choose one, make it accessible to students, and integrate it into the system under development. The primary focus is on the platform's compatibility with various programming languages used in the various courses offered at Central Philippine University, College of Computer Studies.

This will then arise from the availability of expanding the content of the current information to further enhance the capability of the system, making it more likely for those who entail it to develop it from a different and better perspective.

The system must expand in order to continue developing and to keep up with the newest programming topics.

Significance of the Study

University. When the university implements innovation, embracing changes can transform the level into a fresh environment that offers numerous benefits. Deploying new and interactive technologies in education may necessitate a combination of technical expertise and intuitive skills.

Faculty. The faculty's need is to understand and effectively communicate how technological resources and strategies can actively engage students in improved and independent learning. Implementing this will enable instructors to fully utilize their

programming skills, allowing them to pace both advanced students and those who require more attention.

   Students. The accessibility of these resources can be most advantageous when students use the CAI more often. Students will intensify and enhance their programming skills by developing programs independently.