



Article

# Self-Directed and Self-Designed Learning: Integrating Imperative Topics in the Case of COVID-19

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**Abstract:** Self-directed learning and self-design became unexpectedly popular and common during the COVID-19 era. Learners are encouraged to take charge of their learning and, often the opportunity to independently design their learning experience. This research illustrates the use of technology in teaching and learning technology with a central theme of promoting self-directed learning with engaging self-design for both educators and learners. The technology used includes existing tools such as web page design, Learning Management Systems (LMS), project management tools, and basic programming foundations and concepts of big data and databases. In addition, end-users and developers can create their own tools with simple coding. Planning techniques, such as Visual Plan Construct Language with its embedded AI, are used to integrate course material and rubrics with time management. Educators may use project management tools instead. The research proposes a self-directed paradigm with self-designed resources using the existing technology with LMS modules, discussions, and self-tests. The research establishes its criteria for ensuring the quality of content and design, known as 7x2C. Additionally, other criteria for analysis, such as Design Thinking, are included. The approach is examined for a technology-based business course in creating an experiential learning system for COVID-19 awareness. Likewise, among other projects, an environment for educating learners about diabetes and obesity has been designed. The project is known as Sunchoke, which has a theme of Grow, Eat, and Heal. Educators can use their own content and rubrics to adapt this approach to their own customized teaching methods.

**Keywords:** self-directed learning; self-directed design; pedagogy; plan-oriented; web evaluation criteria; design thinking; COVID-19; self-awareness system



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## 1. Introduction

Self-directed learning and self-design became unexpectedly popular and common during the COVID-19 era. Learners were directed to do their learning and, in many instances, design on their own. The concept of self-directed learning theorem focuses on the idea that learners have the capacity to acquire knowledge independently and take an active role in their own learning process. The learners take ownership of their learning, set goals, and engage actively in the process of acquiring knowledge and skills independently [1,2]. COVID-19 has brought about significant changes in educational systems, shifting them from traditional learning approaches to more flexible ones. This transformation aims to ensure accessible education through various modalities, utilizing a range of learning tools and online systems. The COVID-19 pandemic has emphasized the importance of flexible learning approaches in meeting the diverse needs of learners, presenting both challenges and opportunities. Furthermore, it has underscored the necessity for innovative pedagogical strategies that foster increased social engagement and interactions among students. [3,4]. The design thinking framework integrates key elements such as knowledge management, knowledge sharing, innovation, and problem-solving, with collaboration and learner-centric activities at its core. This framework encompasses six stages—empathize, define, ideate, prototype, test, and implement—each of which holds relevance in the context

of knowledge management [5]. This research illustrates the use of technology in teaching and learning technology with a central theme of promoting self-directed learning with engaging self-design for both educators and learners. The technology used includes existing tools such as web page design, Learning Management Systems (LMS), project management tools, and basic programming foundations and concepts of big data and databases. In addition, end-users and developers can create their own tools with simple coding.

Plans are sets of actions or strategies put together to achieve specific goals. Plans involve a set of steps to accomplish desired outcomes and are essential for effective problem-solving and decision-making [6]. Planning techniques, such as Visual Plan Construct Language with its embedded AI, are used to integrate course material and rubrics with time management. VPCL has proven to be effective for novice programmers in learning programming and problem-solving [7]. Educators may use project management tools instead. Problem-solving conceptual models serve as effective strategies for learners to achieve their goals. These models foster the development of critical thinking skills, promote intellectual growth, and enhance decision-making capabilities. Alongside the importance of supporting environments, these concepts are essential for learners in their educational journey [8]. A self-learning problem known as a plan with its designated design can be broken into smaller subunits called sub plans to create a new plan. For each of the two plans, there are four ways to combine the plans, known as append, interleave, embed, and branch plans. A visual design presentation facilitates the understanding of these plan integrations at each stage and, similarly, their decompositions. There are four ways to ensure learning by error checking of a plan known as missing, misplaced, malformed, and misrepresent. The entire planning of the system operates with three selective modes of rehearsal, integration, and creation/innovation phase. In the rehearsal mode, the entire creation of the plans for a problem can be observed. In the integration mode, the plan integration of two plans is tested and combined with the help of the system based on the intention of the learner. In the creation/innovation phase, a plan is created from the existing plan in the system library/database or entirely from scratch. The research proposes a self-directed paradigm with self-designed resources using the existing technology with LMS modules, discussions, and self-tests. The research goal is to promote self-directed learning with self-design in the development of self-awareness systems for imperative topics such as COVID-19.

The research establishes its criteria for ensuring the quality of content and design, known as 7x2C. The 7x2c, or the seven pairs of Cs, represent important aspects such as Content and Context, Correctness and Credibility, Currency and Continuity, Completeness and Coverage, Consistency and Conciseness, Community and Customization, and finally, Compelling and Creativity. Additionally, other criteria for analysis are included. The approach is examined for a technology-based business course in creating an experiential learning system for COVID-19 awareness with four plan-page designs: Informative, Diagnostics, Simulations, and Solutions. Approximately twenty students in a course known as Web Systems and E-Commerce were engaged in this research for several terms beginning in Spring 2019 at the peak of COVID-19 and given the rubric and direction to go ahead with the self-learning and self-design of their own system for COVID-19 awareness or a similar project. The creation of a supportive and collaborative learning environment, incorporating transformative moments, plays a crucial role in fostering meaningful connections and cultivating a sense of belonging among learners. These models offer several benefits, including increased engagement, motivation, collaboration, and personal growth. [9] Each learner submitted and presented their project, adhering to the provided self-directed learning rubric and employing a self-designed methodology. The process of developing the self-awareness system fostered a sense of belonging and pride among learners, empowering them to exercise their own autonomy in the learning process. Learners were able to achieve the task of building a desired system, such as a COVID-19 self-awareness system. They combined multiple frameworks and demonstrated intermediate work completion instead of just producing a final result at the end of the semester. This approach allowed for flexi-

bility, rapid development, and immediate design, which are advantages over traditional learning methods. Likewise, among other projects, an environment for educating learners about diabetes and obesity has been designed. The project is known as Sunchoke, which has a theme of Grow, Eat, and Heal. Another project for programming tutorials, as well as a project for teaching and learning materials in the course Web Systems and E-Commerce, has been examined. Educators can use their own content and rubrics to adapt this approach to their own customized teaching methods.

## 2. Self-Directed Learning with a Contemporary Topic: COVID-19

The research connects COVID-19 as a contemporary topic to the “Web Systems and E-Commerce” business course curriculum by making learning applicable to real-life scenarios and creating an engaging atmosphere. The most challenging part is the moment of spark and project integration, but seeing the intermediate results delivers satisfaction among learners. This research explains how learners can use COVID-19 in four phases: informative, diagnostic, simulation, and pattern matching for trends and solutions. The design of the project includes a set of frameworks and an initial setup using materials from the course, such as creating a web page to keep track of self-learning and self-design. The task of each learner is to customize the work and transform learning in collaboration in each of the four phases and processes.

The course covers topics such as web technology, web design, website analysis, and creating an e-commerce store from scratch with techniques in web hosting. The web design includes the basics of HTML coding and programming with JavaScript and C++. However, learners have the freedom to choose an existing template or work on their own. The recipe for homemade criteria for web analysis, known as 7x2 C's, is illustrated throughout the course. For example, learners are directed to collect “Correct and Credible” information about COVID-19, such as WHO and CDC, when creating the informative phase.

The course requires learning and applying the basics of programming on the web page. The learners were directed to build a simple diagnostic program that finds diseases that have co-symptoms of COVID-19. Similarly, they were asked to find a game or simulation program that mimics COVID-19's interaction with the body's cells. The learner is given a language translator program from English to Spanish written in JavaScript. The task is to convert the translator program to a diagnostic program by changing the variable names and input/output display messages [10].

The web color code (RED, GREEN, BLUE) hexadecimal or binary is used for the presentation of the data for COVID-19 cases to pattern-match and find the possible trend by applying a certain mask to the data. In the early stage, learners are directed to acquire web hosting accounts and publish their COVID-19 web page to share their experiences and challenges. This research has been an ongoing effort since the Spring of 2020, continuously improving ways to direct self-learning with self-design by adding new values.

The COVID-19 pandemic has disrupted the normalcy of society by forcing people to distance themselves from each other through “social distancing” and limiting physical contact as a crucial strategy to curb the spread of the virus. The limit on physical contact and isolation is a key remedy to keep the infection from non-infected people. In order to stay safe, people live in isolation (quarantine) and are encouraged to stay at home until it is safe to be around others. People rely on themselves to carry out their day-to-day business rather than waiting for others to do it for them. On many occasions, people design their own tools and environments and self-direct their learning. Technology has become a tool for reaching out and being part of the solutions for individuals experiencing social isolation and loneliness. Many institutions have adopted learning management systems for teaching and learning, and many businesses have moved to virtual platforms, including healthcare.

Self-directed learning (SDL) has been an effective strategy in education for decades, and it is a core concept in adult education, which has become a popular choice, ranging from cooking and self-study to work and communication. Most importantly, learning ways

to improve the quality of health and life and combat the pandemic has become even more important in self-directed learning.

Self-learning during this time added another dimension and a necessity for the self-design of tools and environments. A tremendous amount of searching was done on the internet to look for designs of what was needed, such as tackling the shortage of Personal Protective Equipment (PPE), workplace (mini office) design, computer interfaces, and web pages, and there was more reliance on social media and 3D printers.

The network and web systems played an important role in providing the means for exchanging information in both self-directed learning and self-design in using and creating tools and environments for health and other life necessities.

This study involved students at SUNY Old Westbury (Long Island) in a business course known as “Web Systems and E-Commerce” during the Spring of 2020 at the height of the COVID-19 pandemic. It was repeated in the Summer of 2020 and the Fall of 2021 semesters and continued until the present time. Additionally, materials from this work are from a collection of four of my conference presentations since 2020.

The students were self-directed to learn the materials given to design their web page first by providing the existing code and viewing the impact. The ultimate plan is to build an awareness system for COVID-19 by collaborating with other classmates and sharing the challenges, new learning, and task experiences of the next level of learning and design.

The content of the page provided to each user in the course is utilized as a basic framework for self-learning direction. The information on COVID-19 is accessed from credible sources, such as the World Health Organization (WHO) [11], and the Centers for Disease Control and Prevention (CDC) [12].

### 3. Design Thinking Pedagogical Framework

Design Thinking, also known as Design-Based Learning, has been used as a tool in teaching and learning. Having originated from the fields of architecture, design, and art, the term was first used in 1987. A pedagogical tool can benefit from compliance with the following seven mindsets that design thinking follows: (1) focus on human values, (2) showing, not telling, (3) creating clarity from complexity, (4) getting experimental and experiential, (5) being mindful of processes, (6) biased towards action, and (7) collaborating across boundaries. The concept has been expanded to other applications in various domains. It is a model for enhancing creativity, innovation, engagement, and perseverance which enables students to work collaboratively in a multidisciplinary fashion incorporating design-led change. The learning cycle comprises experiencing, reflecting, thinking, and acting. Additionally, it is a model of knowledge development, knowledge use, and knowledge building [13].

### 4. Learning Criteria Framework: Web Error Analysis

To design and evaluate a web page, the criteria established in the course are known as “7x2 C” [14]. These criteria are provided by the instructor to the user for ongoing design and evaluation. In the design and evaluation of a web page, there are seven layers of the website. The seven pairs of Cs are shown below:

- Content and Context;
- Correctness and Credibility;
- Currency and Continuity;
- Completeness and Coverage;
- Consistency and Conciseness;
- Community and Customization;
- Compelling and Creativity.

#### The 7x2 C criteria definition and examples:

*Content and Context:*

Each page on the website should have content that is relevant to the context of the page’s topic and meaning. This volume of information should be helpful and informative.

For example, in the case of COVID, the content should provide basic facts about the virus and the pandemic. For any other topic, the necessary content with the related context should be gathered and provided.

*Correctness and Credibility:*

The content and context of each page should be correct and credible to build trust and provide accurate information. In the case of COVID, the content on each page should use correct and credible sources such as the CDC and WHO. Web users need to obtain information correctly. For any other topic, the correctness and credibility of the content and posted material should be in the mindset of the learner. Credible sources from journal articles are encouraged.

*Currency and Continuity:*

Each page should be up-to-date and have a history and a vision for the future with currency and continuity. In the case of COVID, there should be a history of the virus and the process that is happening at the current time, along with predictions and events, such as updates on progress. Time management with social presence has been enforced.

*Completeness and Coverage:*

A website should cover all necessary areas under consideration with complete information and coverage. Regarding COVID, all important subject matters should be presented with a visible link. In another topic, the entire area under study has been identified, each with its coverage to be completed.

*Consistency and Conciseness:*

Each page should be consistent in its format, images, and style. Additionally, the page should be concise to avoid overwhelming the reader. For COVID-19 content, the page should use appropriate formatting, images, and styles throughout the site and provide only essential information. For other topics, learners should be trained to apply consistency to their workspace and practice the art of conciseness and abstraction.

*Community and Customization:*

When designing a page, it should be tailored to the needs of its users. For COVID-19 content, the audience of the page should be taken into consideration.

*Compelling and Creative:*

A page should be compelling and creative by incorporating art and innovation. For COVID-19 content, using appropriate colors and backgrounds with special features and effects, such as video and sound, should be considered for the graphic design.

## 5. Layers of Website Design and Evaluation

A webpage can be designed and evaluated for its purpose and functionality in the following seven layers:

1. Application and Development—This layer identifies the purpose of the website, its target audience, and the features and functionalities required to fulfill its intended use. It does so by applying the “who, what, when, where, why, and how” approach to determine the use and purpose of the page;
2. Appearance—This layer focuses on the overall look, animation, features, and clarity of the webpage to create a visually appealing user experience;
3. Search Engine—This layer ensures that the webpage locates the right information and the right amount promptly, improving the user’s search experience;
4. HTML—This layer covers the important HTML commands (tags) properly, ensuring that the webpage is structured correctly and optimized for search engines;
5. Client-Side Programming—This layer incorporates JavaScript programming for the interface and validation, allowing for dynamic and interactive elements on the webpage;
6. Server-Side and Database—This layer incorporates server-side programming and database-user login and responses to enhance the webpage’s functionality and performance;
7. Security, Privacy, and Ethics—This layer considers protective measures and policies for security, privacy, and ethical issues to ensure the webpage is safe and trustworthy for users.

## 6. Self-Directed Learning and COVID-19

The first step in self-directed learning is for users to understand what they need to do and what materials they need to access to gain the necessary knowledge. The next step is to utilize the acquired knowledge and apply it creatively and innovatively. In the case of COVID-19, self-directed learning can help individuals manage and seek remedies for the virus.

Information related to COVID-19 includes the fact that it affects people differently, ranging from asymptomatic or mild cases to severe or fatal cases. Some of the reasons people react differently to the virus are certain underlying health conditions, dietary intake, environmental controls, genetic predisposition, and immune system function. Other reasons may become known in the future.

## 7. The Aim of the Self-Learning System

The aim of the self-learning system is to incorporate learning materials that raise awareness about COVID-19 in a gradual way. This can be accomplished by engaging and assisting self-learners, who can collaborate and share their new knowledge with the database. The system is divided into four categories for COVID-19, known as

1. Comprehend;
2. Combat;
3. Coexist/Cope;
4. Trace/Pattern matching.

The ultimate goal of the system is to collectively find a pattern that provides hints for a cure for COVID-19. This makes self-directed learning with self-design a successful technique that contributes to the quality of education in our lives.

## 8. Self-Design Framework—COVID-19: Plan-Oriented Approach

There are two key considerations in designing a system for COVID-19 awareness. First, the learner must understand the technology/code that creates the system. Second, health and medical information is necessary for the system to effectively raise awareness. Additionally, learner participation, information sharing, and creativity should be considered when developing the system from scratch. Special measures are taken to ensure that the awareness system is as simple and user-friendly as possible. To design the awareness system, a plan-oriented approach has been introduced.

## 9. Plan-Oriented Approach: Integration

In the plan-oriented system, any task that performs an action or provides information is considered a plan. A plan can be combined with another plan to form a larger plan, and this trend continues to form the entire system as a plan.

For plan integration, there are four ways to combine two plans, which are shown below. Plan integration can be illustrated visually for better understanding.

1. Append Plans:
  - The plans are placed next to each other, and the action after one plan goes to another plan. Therefore, Plan B is after or on top of Plan A.
2. Interleave Plans:
  - The plans are intertwined with each other. After a quick start of Plan A, Plan B begins, and then it goes back to Plan A, and so on.
3. Embed Plans:
  - One plan is entirely in another plan; therefore, Plan B is entirely in Plan A.
4. Branch Plans:
  - A plan is an alternative to another plan, therefore selecting either Plan A or Plan B.

## 10. Plan Oriented Self-Design System Phases

To facilitate the teaching and learning of self-design, the entire system has been divided into three phases based on plan orientation:

1. Rehearsal (Observation) Plans
  - In this phase, the learner can visually observe how the entire system is created via plans that include the name, description of the plans, and how the plans are integrated and detailed.
2. Integration (Composition) Plans
  - In this phase, the learner can visually observe how two plans are integrated to provide the content and name of the newly formed plan. For a known system plan, integration as a smart agent helps the learner choose the right decision. The trend of integration can be repeated until the entire system has been created.
3. Creation (Innovation) Plans
  - Lastly, in this phase, the learner can visually build their plans by borrowing a plan from the system, modifying an existing plan, or creating an entirely new innovative plan that can be added to the system for future use.

The required knowledge for this self-design includes a basic understanding of information systems, programming, web design, project management, and e-commerce. Self-learning can be incorporated in parallel with other topics of interest for new systems.

## 11. Integrating Contemporary and Imperative COVID-19

COVID-19 has been chosen as a contemporary and imperative topic to be incorporated into the business course Web Systems and E-Commerce. However, learners can choose their own interests and match them with the COVID-19 system. Before COVID-19, the Sunchoke project was used to grow, eat, and heal with its web page, products, and services. This project has been known throughout the campus for more than a decade. Some of the contemporary topics that have been tested include programming, torture, mindfulness, art and poetry, marketing and business plans, and the stock market.

The COVID-19 self-designed system skeleton is built on four plans: prevention, detection, simulation, and solution. The content for each plan is provided to learners from a credible source, and learners are encouraged to expand their knowledge and engage with other participants to obtain new learning that can be added to their plan. Learners are also encouraged to think abstractly and simplify details as much as possible to avoid becoming overwhelmed by the system. Therefore, the system can be expanded or shrunk depending on the knowledge provided or acquired. The layout and format for the web, as well as the links for the plans, can be modified to the learner's preferences. The basic programming code for the diagnostic portion of the plan amounts to twenty lines and is currently written in JavaScript. A sample game is provided to demonstrate the interaction of the virus with human cells. Additionally, a database and a program written in C/C++ are provided to be hosted on the web server for interaction with the system. As a contemporary and imperative topic, COVID-19 has been incorporated into self-learning and self-design web systems and e-commerce in the following four categories of plans that are shown below.

## 12. Informative Plan

This plan focuses on providing information about the COVID-19 virus, including its history, prevention, spread, and general knowledge. The information will be provided from credible sources such as the CDC and WHO and will be subject to the 7x2 C criteria to ensure quality. Learners are encouraged to share the content and build trust within their teams for collaborative learning.

### 13. Diagnostics Plan

A multidisciplinary study integrates artificial intelligence, simulation, and monitoring observation to combat the disease and its spread and predict its trajectory [15]. An AI-learning-based system is used to assist in diagnostic support for the assessment of imaging findings of the disease [16]. This plan concentrates on diagnosing the virus using co-symptoms and is based on inference rules. Initially, the diagnostics plan starts with a few systems and diseases that have similar symptoms. This can be expanded to ten or more symptoms as the learning progresses. The learners are provided with a small search program that uses associative arrays to hold symptoms and the corresponding disease, with interaction to find a possibility for COVID-19. After having more than several symptoms, the number of symptoms can be adjusted. The search program is given in JavaScript due to the nature of JavaScript client programming embedded in the web. A learner can add their weight to rank a disease for better probability and accuracy. The items in the array can be increased upon the discovery of new symptoms.

### 14. Simulation Plan

An agent-based simulation models a network of susceptible, exposed, infected, and recovered individuals, known as SEIR, to investigate two network strategies for mitigating the spread of disease while maintaining economic activities [17]. This plan focuses on how COVID-19 interacts with body cells and enters the body. A simulation game is used to mimic the interaction with four scenarios:

1. Virus defeats the body's cells: The virus replicates itself with an assigned degree by the learner and generates itself in a recursive behavior;
2. Body cells defeat the virus: The body cells win and prevent the survival of invading viruses;
3. Virus and body cells remain neutral: The virus sustains a chain of transmission to coexist;
4. The COVID-19 virus turns into a positive virus: The virus becomes part of the body and stays neutral or becomes a useful virus.

### 15. Trace Pattern Matching Database-Solution Plan

A pattern-matching system processes intelligent algorithms to identify significant associations and patterns within the data. The outcomes will aid in understanding the spread of disease and its progression [18]. This plan focuses on finding patterns for COVID-19 by collecting information on individuals and trends that have been discovered. A trend could be by blood type, age group, or vaccination, among other factors, such as underlying conditions and even existing disparities in race and ethnicity. One way to present individuals or cases is to use an ID that can be broken into sections, with each section presenting a situation. Computer bits/bytes/words have historically been used to present different tasks and operations, enabling more than gigabytes or terabytes of different variations in the population of humans on Earth.

The web color code, which is built on three colors (red, green, and blue), or RGB, is used to identify subject IDs in a unique way to trace COVID-19. Each color has eight bits (or bytes) that range from 0 to 255, creating a total of 256 different colors. This results in 16,777,216 assorted colors that can be used for subject IDs in different situations of COVID-19 in the study. These colors can be represented in 24-bit color through binary, decimal, or hexadecimal from 000000 to FFFFFF, ranging from black to white.

A case of COVID-19 can be presented with 16 shades of redness, which state the degree of severity. Having data in binary form enables the system to mask each part of the data for an assigned purpose. To organize the data, four separate databases will be attached to the system, incorporating asymptomatic, mild, severe, and fatal cases or issues, creating a data mart for analysis.

The study will shed light on what has happened (to describe), what to predict, and what to prescribe by applying an algorithm to solve the problem.

## 16. Conclusions

The study promotes the use of technology in self-learning with self-design as a pedagogical technique and tool in teaching and learning in an attempt to meet the best of the curriculum and learners' interests. The COVID-19 pandemic is used as a contemporary and imperative topic for this project. However, learners can select their topic of interest and transform their learning from the COVID-19 case. Creating a network of learning systems with learners' collaboration incorporating the sample case of COVID-19 is the aim to achieve a health awareness system throughout the Web System and E-Commerce course. The self-learning framework is based on the concept of 7x2C criteria as an assurance of compliance to assess the effectiveness and efficiency of the system. The self-design framework is plan-oriented and based on the concept of plan and plan integrations and their spatial relationships. The learners are directed to design the system to comprehend, combat, coexist, cope, and trace COVID-19 with four layers of diagnostics, simulation, and pattern-matching database with the collaboration of learners. There are three teaching and learning phases in which learners can observe the entire creation, engage in partial integration, and create their plans entirely. The technical contribution and novelty of the research lie in the combination of frameworks such as Design Thinking, (Visual Plan Construct Language (VPCL), and web page analysis based on the 7x2 C criteria. Based on collecting facts and data, a mini data mart is established to search for patterns and trends for an algorithm to tackle a solution to COVID-19. Throughout the Management Learning System modules, the requirements and specifications of creating a self-awareness system have been introduced. Discussions serve as a forum for communication and engagement among learners, where they can share ideas and challenges. Self-tests are conducted to ensure and evaluate the learning process and comprehension of COVID-19. The success of the 7x2 C criteria relies on factors such as credibility, coverage, timeliness, consistencies, community, and creativity. Educators and learners both ensure compliance with the content and appearance of online materials.

In conclusion, throughout the learning journey, every learner demonstrated their commitment by submitting and presenting their projects in accordance with the prescribed self-directed learning rubric and employing a methodology of their own design. The experience of developing the self-awareness system not only instilled a profound sense of belonging and pride among the learners but also empowered them to embrace their autonomy and take ownership of their learning process. They combined multiple frameworks and demonstrated intermediate work completion instead of just producing a final result at the end of the semester. This approach allowed for flexibility, rapid development, and immediate design, which were advantages over traditional learning methods. Learners were able to achieve the task of building a desired system, such as a COVID-19 self-awareness system. By providing a large imaging dataset, an AI-based system can generate accurate and reliable outcomes using machine learning algorithms. To increase accuracy, a human expert can be involved to validate the findings through double-checking or random testing of the diagnostic system. The goal of AI-based systems is to mimic human expert systems. The approach of using co-symptoms and inference rules to diagnose COVID-19 is a traditional one that can be employed to build an expert system. Learners gain a better understanding of these inference rules and relate them to their own experiences. Additionally, alternative detection techniques like RT-PCR testing can be incorporated to build a comprehensive diagnostic system.

Sunchoke projects, as a product and service system, have been used at the teaching institution for some time, and students have participated in the project in the business contest. The other topics under consideration are programming tutorials and innovation systems, learning, and teaching via art and poetry. This study and the idea of self-learning with self-design need further investigation, along with their implications, possibly on COVID-19 or any other imperative topic.

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