

## Is it feasible to design learning media "Tomato Plant Growth" hydroponically based on the discovery learning model?

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### KEYWORDS

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**ABSTRACT** Information technology has significantly transformed various facets of life, including education, specifically the learning process in higher education. Integrating information technology in education has empowered students to create and utilize diverse digital learning resources. Mobile devices play a vital role in improving student learning outcomes in hydroponic plant growing lessons when used as an additional tool with demonstration and discovery learning approaches, often known as demons-disco learning. This course utilizes hydroponic techniques and mobile devices to improve students' understanding and skill in cultivating vegetables. Mobile applications offer innovative experiences in information and communication technology and opportunities for students to engage in self-directed learning. The chosen learning methodology involves imparting extensive knowledge, a thorough understanding of many components and variations, and an assessment through inquiries about the cultivation of hydroponic plants. Thus, a teacher must develop instructional material that helps students overcome difficulties associated with cultivating hydroponic plants. This study employed a research and development (R&D) approach to fabricate a product, encompassing three of the four research phases: definition (identifying possibilities and issues, gathering data), product design, and development (validating the design, improving the design, and testing the product). Nevertheless, this research is limited to the third phase, notably the validation phase. The findings suggest that the THD (Tomato-Hydroponic-Demonsdisco) learning media is suitable for use. This article will thoroughly analyze THD media and its utilization in lectures.

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## 1. INTRODUCTION

The introduction of information technology has changed many aspects of life, including education (Dahliani, 2019), especially learning in higher education (Hariati et al., 2017). Information technology in education has enabled students to produce and use various digital learning materials (Gericke, 1937; Yadav, 2020). Mobile development has several benefits due to digitalization. M-Learning uses mobile phones to deliver text, graphics, animation, and video. Students can learn anywhere and anytime with mobile learning or m-learning. Internet technology is widely used in m-learning in many educational institutions. Technological advances influence learning, especially in delivery systems using the latest media (Cometti, 2008; Yuniwati, 2011). Technology helps in authentic learning. Education uses apps like Canva to help students discover their talents and improve their understanding of learning.

Canva, an online visual communication and design tool, allows users to create and share strategies from anywhere (Gilmour, 2019; Yuniwati, 2020). Canva, a web-based graphic design software, will enable users to create posters, presentations, infographics, cards, and more. Canva will

allow teachers to develop technology-based learning resources. Canva has many beautiful layouts to engage students in learning. Canva helps teachers create engaging educational materials to improve education. Educational media can inspire new goals, increase motivation, engage students, and influence them psychologically. Educational media can help students understand, analyze (Kumar, 2022), and simplify information (Sugiono et al., 2023). Canva uses hardware to facilitate print and audio learning. Students benefit from using media, especially in hydroponic plant cultivation classes. Tomato plants can be grown hydroponically. Hydroponics grows plants without soil. Hydroponics avoids tillage, weeds, and fertilizers, making it easier to clean water efficiently. Continuous plant growth results in higher quality, yield, and management regardless of the season. Said this plant can be planted on narrow land. Teachers must be able to describe objects, events, rules, and task steps directly or through relevant learning media. The Demonstration Method is the right choice for teachers as a learning method.

Information technology has significantly transformed various facets of life (Dahliani, 2020), particularly the realm of education (Muddarisna et al., 2021), specifically in the

context of higher education. Integrating information technology in education has empowered students to create and utilize diverse digital learning resources. The digitization of mobile development offers numerous advantages (Fitriana et al., 2020; Yuniwati et al., 2023). M-Learning uses mobile phones as a means of transmitting information in the form of text, graphics, animation, and video. Mobile learning, often known as m-learning, enables students to acquire knowledge and skills at any location and time. M-learning is extensively utilized in numerous educational institutions that use Internet technology. The progress of technology has a significant impact on the learning process, particularly in the utilization of cutting-edge media for instructional delivery (Pratiwi et al., 2023). Technology facilitates genuine learning. Education employs applications such as Canva to encourage students to uncover their aptitudes and enhance their comprehension of the material.

Canva, an internet-based visual communication and design platform, enables users to generate and distribute strategies from anywhere. Canva, an online graphic design software, allows users to create various visual materials such as posters, presentations, infographics, cards, and other designs. Canva enables educators to develop technology-driven educational materials. Canva offers many aesthetically pleasing templates that captivate pupils and enhance their learning experience (Joshitha, 2021). Canva facilitates the creation of captivating educational resources by teachers to improve the quality of instruction. Educational media has the potential to stimulate fresh objectives, strengthen motivation, captivate pupils, and have a psychological influence on them. Educational media facilitates students' comprehension, examination, and streamlining of material (Latipun et al., 2022). Canva employs hardware to simplify the process of print and audio-based learning. Students derive advantages from using media, particularly in hydroponic plant cultivation lessons. Hydroponic cultivation allows for the growth of tomato plants. Hydroponics is a method of cultivating plants without the use of soil. Hydroponics circumvents the need for plowing, the growth of unwanted plants, and the use of substances that promote plant growth (Febrinda et al., 2023), thereby simplifying the process of efficiently purifying water. Uninterrupted plant development leads to improved quality, productivity, and control, irrespective of the time of year. This plant is suitable for cultivation in small spaces. Teachers must possess the ability to articulate descriptions of things, events, rules, and task phases either verbally or by utilizing appropriate educational resources. Discovery learning is an optimal choice for instructors as a pedagogical approach.

Implementing the discovery learning model for teaching the core concepts and techniques of hydroponic plant culture helps foster students' engagement in learning about plant cultivation. This model establishes a connection between the subject matter and real-life experiences (Martunis et al., 2023), enhancing students' interest. The information acquired through exploration possesses various virtues. Firstly, knowledge exhibits greater durability or enhanced retention capacity than knowledge gained through alternative means. Furthermore, discovery learning outcomes show a superior transfer impact compared to alternative learning outcomes. However, the cognitive notions and principles that belong to an individual are readily applicable to unfamiliar scenarios (Anggraini et al., 2022;

Sugianto et al., 2023). Furthermore, discovery learning enhances pupils' logical thinking and capacity for independent thought. Discovery learning specifically develops students' cognitive abilities to independently identify and resolve problems without relying on assistance from others (Dahliani, Shumaila, et al., 2023).

The discovery learning approach can be executed through one-way communication, such as a reflective lecture, or two-way communication, such as guided discovery. The one-way discovery learning paradigm entails students actively engaging in the discovery process without any interference or guidance from educators (Haanurat et al., 2022; Le et al., 2023). On the other hand, the Guided Discovery model of learning through two-way communication entails students responding to instructor questions. Students make new findings, while educators provide guidance and direction (Dahliani, Purnomo, et al., 2023). In this paradigm of driven discovery learning, educators assume the role of guides as students engage in the discovery process. This project employs a guided discovery learning methodology to facilitate students' comprehension of producing tomato plants using hydroponics.

Sahabuddin (2007) has noted that certain concepts can only be acquired through self-discovery, even though they should be examined using the discovery model due to the substantial time investment involved. Consequently, the scope of discussion needs to be constrained. For learning to be beneficial, this model must be supplemented with additional methods such as deduction, logical reasoning, or demonstrations conducted by educators or through reading literature (Gijlers, 2013; Wicaksono et al., 2021). The statement above incorporates approaches demonstrating the guided discovery learning model on the primary subject matter of electrolyte and non-electrolyte solutions. The demonstration approach involves the presentation of lessons by showing and visually illustrating a certain process, scenario, or object, either through actual implementation or a simulated representation (Dahliani, 2024). The utilization of demonstrations is quite successful as it enables students to discover answers through their endeavors, relying on accurate facts and data. Demonstration, as a presentation technique, is inherently intertwined with vocal explanation by the educator. While students are primarily expected to pay attention during protests, it is worth noting that demonstrations can provide more tangible learning material (Pamuji & Dahliani, 2023). This demonstrative method can stimulate students' inquisitiveness to seek explanations for the outcomes of their conducted observations.

According to Østbø (2017), a demonstration displays or exhibits something. Pupils acquire a process via observing demonstrations conducted by teachers or fellow pupils. The demonstration technique imparts knowledge on the utilization of an instrument or execution of an activity in practical situations. Demonstration is an instructional technique where a teacher directly exhibits a concept or ability, enabling pupils to watch and comprehend it more effectively, thereby enhancing memory retention. Implementing discovery-based learning can achieve this outcome (Nurlina & Dahliani, 2022). Discovery learning is a pedagogical approach. Discovery learning facilitates the acquisition of problem-solving skills in pupils through their active pursuit of solutions. Educators must cultivate a sense of motivation in youngsters to acquire knowledge.

Engaging in active learning instead of passively listening will energize kids (Bongelli, 2020; Elion, 1995). Discovery learning facilitates students' behavioral change by actively involving methodical, critical, and logical investigation and exploration to uncover information, attitudes, and abilities. The demonstration approach incorporates the utilization of discovery learning (Saleh et al., 2021). Demon-Disco: Exhibition and search Learning integrates many instructional approaches to elucidate the teacher's role in implementing or showcasing resources. Subsequently, students can enhance their search capabilities for self-directed learning: character traits and abilities.

Preliminary findings at the Bogor Agricultural Institute (IPB) indicate that agribusiness, food crops, and horticulture capabilities, particularly in hydroponic crop production, have exhibited unsatisfactory performance in recent years. Utilizing Canva-based learning material is highly efficient for enhancing students' understanding and vocational proficiency in hydroponic plant cultivation. Using Canva as an educational tool for hydroponics has been extensively studied. The configuration and utilization of media distinguish this research. The plant culture course in its fourth semester uses Canva to enhance student learning. The demons-disco learning approach accomplishes this. Smartphone applications based on Canva improve learning results for students nurturing hydroponic plants. The book is furnished with graphic aids and exemplifications. The software provides hydrotherapy instructions sequentially, accompanied by visual aids, enabling students to acquire knowledge autonomously. Both digital and tangible media can be utilized. There is a video that contains explicit content. There is a conversation menu available. Additionally, this media was created in response to the COVID-19 pandemic, and this research employs 4-D development. Prior learning was conducted through internet platforms utilizing PowerPoint presentations. The Borg & Gall development approach was used solely for design purposes. The media produced in classroom action research is subjected to testing. Canva has yet to be utilized as an educational tool by researchers and teaching staff at IPB. Their sole sources consist of PowerPoint or YouTube videos. Hence, it is imperative to undertake more research to provide innovative educational resources that will enable students to acquire knowledge on cultivating tomatoes through hydroponics. The Canva application was built to instruct 4th-semester students at the Bogor Agricultural Institute on hydroponic plant growth. This topic will be enhanced by utilizing the in-app Demons-Disco Learning Method.

## 2. METHOD

Researchers and developers (R&D) utilize systematic methods to create and test goods. Figure 1 shows Thiagarajan's four-step R&D plan.

Figure 1 shows the linear co-cost product development process: define, design, create, and deploy. This research will focus on the first three stages of product development, starting with definition (Riyadi et al., 2022). Prescribed actions include analyzing options and identifying problems. Condition-devaluating literature mining concepts and research findings from SINTA, Garuda, and Scopus are used for this task (Solehudin, 2023). A first inspection was done at the Bogor Agricultural Institute (IPB) research site. To gather profiles, data, and student academic assessments of



Figure 1. Flow of the stages of developing Demons-Disco media

the hydroponic plant growth course's theoretical and practical components. Data is collected during definition to set research goals, generate new ideas, and estimate energy, time, and site resources. Canva software is used to design plant cultivation teaching resources in the second step. Design validation, the third stage of development, assesses product efficacy (Sungkawati et al., 2023). The exam has questionnaires for validators (design professionals), students (media users), and teachers. According to the validation expert, an assessment goal is valid if it scores at least 75% for all questions (Lubis et al., 2024). If product results indicate that the researcher's initial design needs validation, design enhancement is done in the third step. Researchers must improve the design until it is validated and ready for execution. IPB tested products in the fourth phase. Design trials classified quantitative data from design and materials specialists' inquiries (Solehudin & Darmayanti, 2018). This Validator experiment included academics from the Faculty of Agribusiness, Food Crops, Horticulture, multimedia professionals, and 25 fourth-semester students. The trial was conducted in a two-cycle educational setting. The curriculum-based final semester test for class 2021-A students consists of 25 questionnaires. The statistic is the average final semester exam scores of 2021-A curricular component students. Duration confined this research to the development stage: media design validation by validators.

## 3. RESULT & DISCUSSION

### 3.1 Results

This project employs instructional media to elucidate principles, construct and refine prototypes (Hendarto et al., 2024), and disseminate information about hydroponic plant cultivation. The main focus of hydroponic farming techniques is on tomato plants. Tomatoes are a well-favored fruit that may be easily cultivated in a hydroponic system (Muddarisna et al., 2020). Hydroponic techniques are widely acknowledged to generate superior tomato plant yields compared to conventional cultivation methods. Modern agricultural technology, such as those used for cultivating tomatoes (Nursaid et al., 2024), can grow var-

ious crop species. This tomato plant growth resource primarily focuses on the language and production of Canva teaching materials and evaluating this medium in the classroom. The educational resource "Hydroponics" was developed to instruct individuals on plant production using the Demons-Disco learning platform (Cottle, 2008; Wertz, 2013). The first phase in creating 4-D learning materials for the Demons-Disco "Hydroponics" study module in the plant culture course on Canva consisted of the following procedures: These definitions were prioritized during the construction of Canva's educational media (Fitriana et al., 2022; Muddarisna et al., 2019). Following preliminary informal observations, they conducted comprehensive observations. The objective of the observations was to thoroughly examine this particular region, which poses challenges for educators when teaching the intricate subject of hydroponics.

To initiate this definition involves consulting with other educators specializing in teaching courses on plant cultivation regarding their teaching materials and the extent of student involvement in their classes. Throughout the semester, commonly utilized evaluation mediums consisted of PowerPoint presentations and video lectures obtained through YouTube searches made by others, which were subsequently distributed to students (Deliyannides, 2016; Enjolras, 2013; Kazun, 2019). The problem that students encounter arises from the necessity for video content to conform to the unique qualities and demands of students in the classroom. There is a need for an instructional tool to assist fourth-semester students in addressing certain challenges (Prasetyo et al., 2020), specifically related to their learning goals in hydroponics, to enhance their comprehension. Subsequent actions: Engage in the discourse analysis study for advanced Canva skills. This Canva topic centers on educational material for the IPB agriculture faculty: cultivating tomato plants utilizing advanced hydroponic techniques. This course introduces fundamental methods for detecting and structuring graphs, allowing students to develop specialized abilities efficiently. In the third stage, learning objectives are analyzed using indicators derived from teaching and learning materials and the curriculum to identify student objectives.

An assemblage of proficient instructors with expertise in plant cultivation was examined and interviewed to furnish design terminology. Follow the instructions for a Canva media design for a plant cultivation course. The design process commences with carefully selecting appropriate media before creating instructional materials. Researchers can enhance their learning efforts this semester by utilizing Canva on mobile phones or other devices (Muddarisna et al., 2019). Therefore, it is easily transportable and does not necessitate laptop usage. The URL [www.canva.com](http://www.canva.com) redirects viewers to Canva, a robust platform that offers a wide range of educational resources and instructional guides. Technology provides students and teachers expedited access to various captivating educational tools.

In the Design Stage, the teacher's teaching structure is modified to suit the learning material using the Canva tool. Canva's educational resources are classified according to several forms of instructional media. Instructors can now assess Canva learning designs. Instructors have the option to forgo the utilization of interactive templates in Canvas. The core focus of the implementation centered

on the Canva application interface. The Canva application can be accessed at the provided hyperlink. Next, click the search button, and the Canva program interface will appear, as shown in Figure 2.

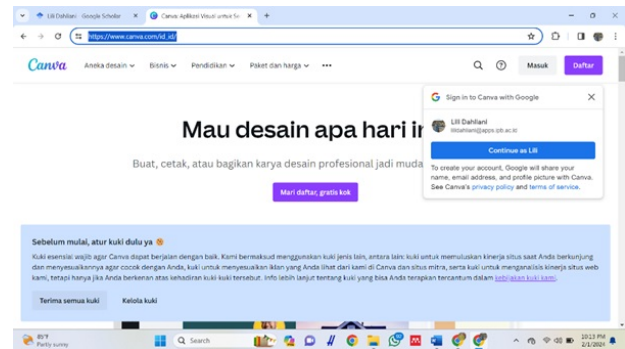


Figure 2. Canva App Display

Figure 2 shows the initial appearance of the Canva application for use in designing THD media. To use the application, select login using several methods. First, you can log in using your G-mail account or another account such as Facebook. Beforehand, make sure to click on cookie policy; this is done so that before starting the application, you are required to set cookies. This aims to smooth the site's performance when used, so select the accept all cookies menu shown in picture 2. Next, select 'enter/login'; after that, you will be directed to the menu where the Canva site asks for information by recommending suitable types of designs/templates with the goals you want to achieve. Here, you can choose the kind of design to be used as teaching material by clicking on the fifth option, which can be seen in Figure 3.

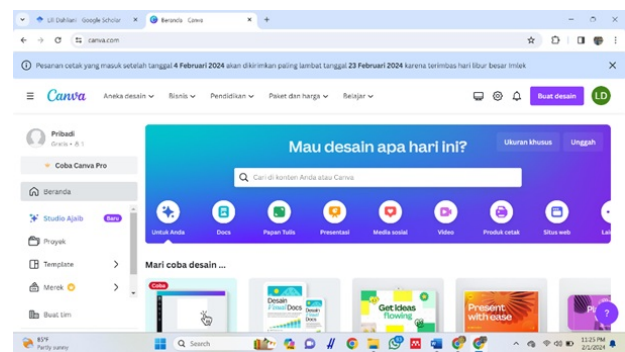


Figure 3. Main Menu of aplikasi canva App Site

In Figure 3, because the aim is to create teaching materials that contain materials, videos, practice questions, practical instructions, and discussions, a presentation template type with an exchange of ideas template was chosen. This creates virtual classes with discussions to exchange ideas through discovery, learning, and demonstration stages. There are many template options available that can be adjusted to suit your needs. During the design process, it is necessary to use other hardware such as Google Chrome, MS, and Canva APK as the main tools for creating informative materials. It is required to conduct a thorough investigation and scan and store digital evidence safely. Next, conduct a thorough inspection and analysis using Fore to explore different materials. Resources are organized and collected in Canva, using carefully de-

signed layouts, backgrounds, audio, and modifications to enhance visual appeal. Finally, the material was converted into Canva to improve the learning process—illegal digital technology. Demons-Disco produces instructional materials about plant culture called "Hydroponic" on Canva. Buttons are created using the ellipse and horizontal tools (Negrine, 2014; Young, 2012). Generate submaterial with the Magic Wand and Horizontal Type tools. Create content icons, meet survey objectives, and conclude using a 3D blender. Logo icons in 3D Blender can be created by manipulating meshes and cubes and arranging them using the Extrude function. Animating text on a timeline involves moving the "Add text" feature around. PNG is generated from text data. The Extrude tool in 3D Blender is used to change the shape of meshes and cubes to create designs for material icons, practice questions, outs, and other icons. The timeline achieves Animated text by moving the "Add Text" feature.

Additionally, PNG can produce animated text. 3D Blender generates 3D sub-material icon designs based on photos (Qomariah et al., 2021). Extrusion changes the thickness of the design. The animation is generated after the timeline moves. The PNG design is complete. This educational media was created using Notepad++, Photoshop, Audition, 3D Blender, Coreldraw, and MySQL. Project deliverables include image designs created using Adobe Photoshop CS6, material icon images, problem-solving and simulation exercises using 3D Blender, and conversion assignments. GIF makes PNG files into GIFs. Drive D categorizes files using folders labeled "denied." This directory includes audio files, graphic symbols, and brand logo.

Furthermore, Notepad++ was used to write code and generate hydroponic learning questions using the PhpAdmin SQL function. Command Prompt is the main software used to create APKs, which combines Cordova commands into one in the Canva APK tool. After that, the media that has been designed will then be validated in the third stage by professionals in the field, including media professionals, topic specialists, and experienced hydroponic plant cultivation lecturers.

Development is the penultimate phase in creating a 4D instruction tool. Product development is the process of creating new products. This method involves expert evaluation, changes, and development testing (Díaz, 2019; Soares, 2016). 1) Expert judgment: Experts recommend changes to the instructional materials—revision of integrated learning media with expert recommendations. Expertise is needed to improve learning content by making it more accurate, effective, tested, and technologically advanced. 2) Development trials collect data from students and observers about the effectiveness of educational materials. To ensure effectiveness, educational materials are frequently assessed and modified. The development process involves the following stages:

Validation evaluates the suitability of the material. Receiving a professional assessment will improve the quality and effectiveness of the media. 1) Comprehensive verification of expert content: An educational specialist in the agricultural sector, especially in tomato cultivation using hydroponic techniques from the Bogor Agricultural Institute (IPB), who uses an Android device, validates digital learning media for plant cultivation. Produce materials, undergo evaluation, and receive guidance from subject experts. We combine information on reproductive health, improve indi-

cators to match learning objectives and provide visual resources to enhance indicator improvement. After verification with topic specialists and valuable feedback, the researchers implemented suggestions from media specialists to improve the cultivation medium of these plants.

To verify accuracy, subject specialists filled out questionnaires after changes in media. The validation report consists of five Likert categories: agree with (SA Media), agree (A), neutral (N), disagree (D), and strongly disagree. The content experiment validation survey comprises 15 indicators (Zhang, 2008). Data-driven material has the potential to achieve higher scores. This instructional media can use the content of this media. Based on the validity results, this value is by reference data in the range 4.21–5.00 (Attia, 2020; Manríquez-Altamirano, 2020). The responsibility for validating digital input media lies with the "media expert." IPB offers a program for cultivating tomato plants using hydroponic techniques by designing lessons using the Canva application, which uses the demons-disco learning method taught by Dr Lili Dahliani.

Validation involves the process of checking boxes in a questionnaire. Researchers found video footage with inadequate contrast, brightness, lighting, and a lack of meaningful substance (Elsayed, 2020; Fuentes, 2018; Yuan, 2019). It is important to include or encourage the establishment of score feedback mechanisms to evaluate student assessments. Enhanced media offers expert explanations in response to modifications and assistance. The diagram below is depicted clearly. After media revision, a media professional completes a questionnaire according to specified parameters to verify its validity.

Canva can function as a demonstrative and interactive learning tool for hydroponic plant cultivation at IPB after validation from media and materials specialists and user validation in product tests. The media experts' validation results were assessed using a ten-question questionnaire. A score of 2.9 comes within the specified range of 2.1–3.0 for this criterion. This presentation aid is effective (Araújo, 2018; Chen, 2021a; Luna, 2018). The material experts checked the questionnaire, which consisted of 10 questions. Validity was 3.6, with a range from 3.57 to 4.00. This categorizes aid as legitimate and highly profitable (Abbas, 2021; Rosa-Martínez, 2021). After the media has been declared suitable, the next step is to carry out trials on the press. Studies show that Canva improves the design composition of the "hydroponic demons-disco" tomato plant cultivation media. The goal behind the increased use of Canva is to enhance the educational experience, especially in writing.

The Canva assessment can facilitate the learning process of "breeding tomatoes using hydroponic techniques" for students. The efficiency of Canva's hydroponic tomato plant guide was assessed during the design phase. Hydroponic methods have been proven effective in growing tomato plants, with Canva being a useful tool for learning. A study was conducted to evaluate the effectiveness of tomato cultivation media using Canva's hydroponic media technique (Nursaid, Faisal, et al., 2023). At this stage, students assess their enjoyment and understanding of the learning material through surveys. Canva is used for additional research resources, such as this survey. There were 25 participants in the survey.

This research determined that Canva is a productive tool for writing instruction. These findings are consistent

with studies conducted by (Nursaid, Smith, et al., 2023). Canva users claim that writing becomes easier and more stimulating and relieves anxiety. Training in language acquisition technology is also provided. Marco (2018) suggests using Canva as a learning tool for Discovery to improve writing skills and motivation. Students are allowed to gain knowledge in dictionaries, idioms, and terminology. The following is an example of the main display of learning media for cultivating tomato plants hydroponically using the demons-disco strategy and some documentation when practical activities are carried out outside the classroom, Which can be seen in Figure 4.

#### 4. CONCLUSION

Incorporating technology in education has profoundly impacted several facets of life, instruction, and information acquisition. Due to advancements in digital technology, students can now utilize a wide range of digital learning materials, including text, images, animation, and video. Mobile and m-learning are frequently employed in educational institutions, where technology significantly facilitates knowledge acquisition. Education uses platforms such as Canva to enhance students' comprehension of and understanding of their learning process. Canva is a flexible visual communications platform that enables users to create various educational materials, such as posters, presentations, infographics, and other forms. Teachers can use educational media to enhance students' knowledge acquisition and analytical abilities and proficiently convey information. This research aims to gather data to identify research inquiries, propose novel concepts for future research, and evaluate the necessary energy, time, and resources. The primary focus is on the "Hydroponics" platform, specifically designed to educate individuals about hydroponic growth in a captivating and interactive instructional setting. This course thoroughly investigates the practice of hydroponic cultivation and its impact on their educational methodology. Evidence from research indicates that using Canva media in teaching can enhance students' comprehension of hydroponic culture and optimize their overall learning encounters. This study emphasizes the significance of integrating Canva technology in education and the necessity for ongoing enhancement.

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