Research Article

Development of interactive learning media based on website chatbots on plant tissue material

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Abstract: The utilization of learning media is a valuable instrument in enhancing the learn-ing process, hence maximizing the attainment of learning objectives. The objec-tive of this study is to create an educational tool for biology instruction in the form of a website chatbot focused on plant tissue content. The research also seeks to evaluate the viability and efficacy of this tool when used by students. The pre-sent study used the ADDIE model, a widely recognized framework in the field of development research. This model encompasses five distinct stages, namely anal-ysis, design, development, implementation, and evaluation. The data utilized in this study was collected via interviews, questionnaires, and tests, and afterwards analyzed employing qualitative and quantitative descriptive statistical methods. The present study developed an educational tool in the form of a website chatbot focused on plant tissue materials. The validation process involved obtaining feed-back from media experts, material experts, and students. The assessment con-ducted by media experts resulted in a 91% rating, categorizing the chatbot as "very feasible." Similarly, the material expert's assessment yielded an 86.5% rat-ing, also falling into the "very feasible" category. Furthermore, students' respons-es indicated a 97.7% rating, categorizing the chatbot as "very feasible." Moreo-ver, based on the study conducted to evaluate the efficacy of learning media goods, the t-test findings revealed a significant difference between the pretest and post-test scores, as indicated by a Sig value (2-tailed) of 0.000, which is less than the predetermined significance level of 0.05. The mean gain for the website chat-bot learning media product is 0.77, falling inside the "high" category. This sug-gests that the product is very suited and effective as a learning medium.

Keywords: Chatbot; education; technology education

1. Introduction

By cultivating intelligence, honing skills, fostering character development, bolstering personality traits, and fostering a sense of unity, we may collectively advance our personal growth and contribute to the progress of our nation. Education is universally recognized as the primary pillar of any nation (Husna, 2017). The caliber of education inside a country is a crucial factor in determining the advancement of that nation. Put simply, the development of a nation or country can be gauged by the caliber of education inside that nation or country (Khaidir et al., 2023). The inadequate educational standards will impede the progress of the nation. An influential factor in the effectiveness of education is the effective application of pedagogical practices and learning activities (Nurhuda, 2022).

The teaching and learning process, also known as learning activities, involves the transmission of messages from an educator (the sender) to the students (the recipients) as a means of communication. Obstacles frequently arise in the communication process between teachers and students, typically due to the student's inattentiveness during the teacher's explanation of the learning process. Utilizing pertinent educational material is an effective method to mitigate students' lack of engagement in the learning process (Arista & Marhaeni, 2018; Dulmen et al., 2023).

The utilization of media in schools is a crucial aspect that contributes to the efficacy of the learning process. This is due to its ability to facilitate the transmission of information between professors and pupils, or vice versa (Arda et al., 2015). Utilizing media in innovative ways can enhance and maximize learning efficiency, leading to maximum achievement of learning objectives (Brame, 2016; Muhtar et al., 2020). Educational media encompasses any medium utilized to transmit messages or instructional material, so stimulating students' cognition, emotions, focus, and aptitude, ultimately fostering an effective learning experience (Wahid, 2018). Putri et al. (2022) further noted that learning media is a very significant component of learning as a bridge in providing material since teachers may quickly transfer material in a simple and easy-to-understand manner. The utilization of media in learning can have a favorable influence and exceptional advantages in facilitating the student's learning process. In order to facilitate effective learning, it is essential to have learning aids such as interactive educational media that make use of technology.

The utilization of technology is seeing a tremendous surge and has permeated every facet of existence, encompassing the economy, healthcare, education, and various other domains. An example of technology integration in education is the National Examination System, which has implemented an online platform for several years. Owing to technological advancements and its integration into education, it is imperative for schools to embrace technology in order to enhance the efficiency of the teaching and learning process, and cater to the demands of tech-savvy students (Bui, 2022; Eisenringan et al., 2024). Hence, technology can be employed to generate interactive educational material to facilitate the learning process. Wati & Nugraha (2020) defined interactive media as multimedia that incorporates a user-operated controller, enabling the user to select their desired actions for the subsequent processes. Seels and Glasgow, as mentioned in Darling-Hammond et al., (2020), argue that interactive learning media is a computer-controlled mechanism that not only presents material through sight and hearing, but also provides positive stimulus and feedback to students.

Astawa & Permana (2020) assert that artificial intelligence technology is considered highly promising for the future of education. Chatbots exemplify the utilization of artificial intelligence technologies within the field of education. According to Adamopoulou & Moussiades in Sugiono (2021), a chatbot is an artificial program that utilizes artificial intelligence (AI) to imitate human-like conversations or chats with users through messaging applications, websites, mobile applications, or telephone. Through text-based communication with artificial intelligence robots, there is an expectation that pupils will develop an interest in studying educational material. A chatbot is a computer software created to imitate an interactive discussion or communication with a human user, using text, voice, or images (Harahap & Fitria, 2020). Zuraiyah et al., (2019), further asserted that chatbots are software programs capable of engaging in natural language conversations with humans. Conversational models employ artificial intelligence to comprehend human speech and deliver pertinent responses pertaining to the issue being discussed by the user.

Chatbots are extensively utilized for creating interactive learning media due to their versatile functionalities. This study involved the creation of a website-based Chatbot. A website is an assemblage of webpages that house specific information and can be readily accessed by individuals, regardless of time or location, through the internet (Attijani et al., 2022). Harminingtyas (2014), defines a website as a compilation of interconnected pages that present various forms of data, such as text, images, animations, sound, and videos. These pages can be both static and dynamic, and are linked together through hyperlinks. Laksana & Fiangga (2022) conducted prior study which concluded that employing online chatbots as a medium for mathematics education was both feasible and efficient. This approach garnered student interest and resulted in enhanced learning outcomes. Moreover, a study conducted by Kasmayanti, Setyaningrum, & Atmaja (2023) affirms that employing website chatbots as educational tools for teaching digestive system content

elicited a favorable reaction from students. This is due to the media's ability to captivate students' interest in learning, enhance comprehension of the material, and facilitate self-directed learning. In previous studies, website chatbots were developed with media content that focused on discussing material only, while in this study website chatbots were developed by adding practice question features and fun rooms that contain games and interesting facts about the material discussed with the aim that the media developed is more interesting to students and can improve more optimal learning outcomes.

Findings from field research conducted at SMA Negeri 4 Tasikmalaya reveal that teachers typically employ the lecture style in their teaching, often utilizing PowerPoint presentations or textbooks as aids. Conversely, throughout the process of learning, certain students have a tendency to neglect the task of actively attending to the explanation of the subject matter. Nevertheless, teachers frequently instruct students to autonomously study and enhance their understanding of educational content by seeking supplementary resources on diverse learning platforms, such as YouTube, educational websites, and ect. Thus, pupils require innovative educational tools to enhance the learning process. Subsequent to the interviews, it was ascertained that students encountered considerable difficulty comprehending plant tissue material, "In studying plant tissue material, I have difficulty memorizing the types and characteristics of plant tissues and it is difficult to distinguish the structure of plant tissues in each organ." This was attributed to their need for assistance in memorizing the various types and characteristics of plant tissue, as well as discerning the structural differences of plant tissue in each organ. Additionally, according to the biology instructor, educators believe they require instructional materials that can engage students' interest and also be efficient in enhancing students' academic achievements.

Researchers created interactive learning medium for plant tissue material using internet chatbots in response to these issues. The learning media package will consist of plant tissue material, accompanied by pertinent photos and videos. Subsequently, animations and game features will be incorporated based on recommendations provided by educators and students. The ultimate consequence of this educational media product is anticipated to serve as a remedy for enhancing students' attention and facilitating their comprehension of plant tissue material, hence perhaps leading to improved academic performance.

2. Materials and Methods

The employed research methodology is research and development (R&D) (Sugiyono, 2020). The development approach employed is the ADDIE model Branch, (2009), which comprises five distinct stages: Analysis, Design, Development, Implementation, and Evaluation. The validation test in this research comprised two specialists: a media expert and a material expert. After the product was revised according to the suggestions of media experts and material experts, product trials were then carried out which included small group trials and large group trials. The small group trial was conducted on a sample of 10 students from class XI MIPA at SMA Negeri 4 Tasikmalaya to assess their responses to the media used for learning. The large group trial was conducted on 32 students of class XI MIPA 1, the purpose was to determine the effectiveness of the product developed.

The eligibility % method is utilized to produce scores derived from validation test evaluations conducted by media experts, material experts, and student answers (Formula 1).

$$Percentage\ (\%) = \frac{Total\ score\ obtained\ (x)}{Maximum\ score\ (xi)}\ x100\% \tag{1}$$

Subsequently, the percentage outcomes of evaluations conducted by media experts, material specialists, and student feedback are employed to estimate the degree of product

viability. The feasibility categories are quantified using percentages, as indicated in Table 1.

Table 1. Category of Eligibility for the Product

Rating Score	Score	Eligibility Level Category
1	81% - 100 %	Highly valuable
2	61% - 80%	Valuable
3	41 % - 60%	Lowly valuable
4	0% - 40%	Unvaluable
5	< 21 %	Highly unvaluable

The data acquired from the outcomes of the product efficacy examination are presented as pretest and posttest scores. The data undergoes multiple phases of testing, specifically the normality test, t-test, and n-gain test, to assess the efficacy of the generated learning media items. The calculation of N-gain is based on the mean gain (g) derived from the pretest and posttest scores. The calculations are as stated in Formula 2.

$$N - Gain = \frac{Posttest\ Score - Pretest\ Score}{Ideal\ Score - Pretest\ Score} \qquad (2)$$

The calculation results are subsequently translated into the n-gain score criterion table, as depicted in Table 2.

Table 2. Criteria for N-Gain Score

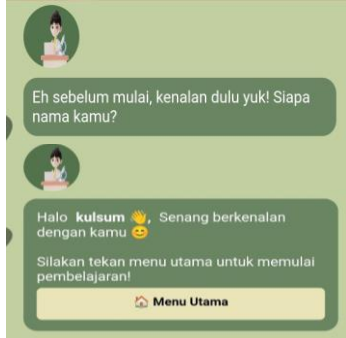| No	Gain Score	Category
1	$g > 0.7$	High
2	$0,3 < g \leq 0.30$	Medium
3	$g \leq 0,30$	Low

(Kurniawan & Hidayah, 2020)

3. Results

The website chatbot learning media on plant tissue material is developed through five stages: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). The analysis stage include the examination of materials, identification of gaps in the learning process, assessment of user requirements for the application, and evaluation of the necessary development tools. During the Design stage, the process involves developing both a material design and a product design. During the development stage, the tasks involve procuring all necessary development tools, creating the product based on the design specifications, verifying its quality with media and material specialists, and assessing user feedback through small-scale trials. This trial is conducted to solicit feedback from users regarding the product under development. During the implementation stage, product trials are conducted on research participants, specifically large groups, to assess the efficacy of the designed product. The evaluation stage in this research is a type of evaluation known as formative evaluation. The objective is to enhance the analysis, design, and development phases prior to and following implementation, ultimately resulting in the creation of a final product that is tailored to meet the needs of students.

The website chatbot learning media employs artificial intelligence technologies to encourage user interactions inside the media (Harahap & Fitria, 2020). This research project is around the development of a website chatbot that specifically targets plant tissue material. The content of this educational resource encompasses the comprehension of plant tissue, various forms of plant tissue, the distinctive qualities and functions of tissue in plants, the structural composition of tissue in each plant organ, and the variations in tissue

structure across different plant organs. The visual representation of the website chatbot product under development is displayed in Table 3.

Table 3. Display of Website Chatbot

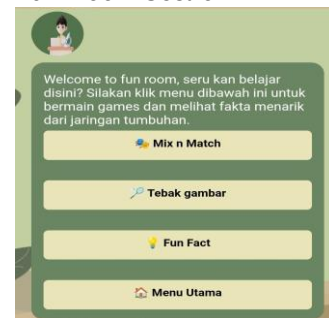| Displays	Data
Opening Section 	The opening screen presents a kind salutation, acquaints the viewer with the content, and guides them to the Instructions for Use section.
Menu Log in 	The login menu prompts the user to enter their name. Once the user has entered their name, a greeting message will be displayed, followed by directions to push the Main Menu button.
Main Menu Section 	The main menu interface commences with a prompt regarding plant tissue material, followed by three primary menu buttons available for user access: Material, Exercise, and Fun Room.
Materials Section 	The material portion commences with an introductory elucidation of plant tissue and is then navigated by two buttons,s specifically Plant Network and Main Menu. If you have commenced inputting the content, each page will elucidate the plant tissue material along with pertinent photographs and videos. Users can utilize the navigation buttons and conversation column to access the subsequent display.
Practice Section	Indicate in the Practice section if the questions are presented in a multiple-choice format. Upon selecting an

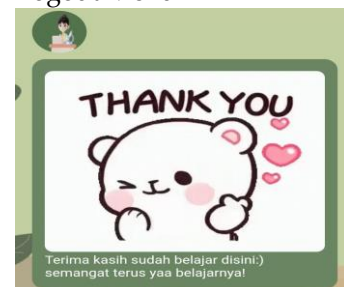| Displays	Data
	answer, a response in the form of a gif will be displayed to indicate if the answer is valid or incorrect. Incorrect responses will be accompanied by the right answer
	The display will present the ultimate value or score achieved upon the user's completion of all the questions
Fun Room Section	The fun room offers interactive games specifically designed to reinforce the information, such as matching phrases and guessing photos of plant tissue. Additionally, there are engaging videos that present fascinating facts about plant tissue
Logout Menu	The gif is shown upon the user's exit from the chatbot.

(Source: Kurniawan & Hidayah, 2020)

Once the product has been designed, it undergoes validation by media and material experts. The validation test findings received from media specialists are presented in Table 4 and Table 5.

Table 4. Results of the media validation test

No	Evaluation Components	Scores	Maximum Score	Percentage of Eligibility
1	Visual clarity	29	32	90,6 %
2	Software engineering	7	8	87,5 %
3	Effectiveness of Media	7	8	87,5 %
4	Utilisation of media	8	8	100 %
	Total Scores	51	56	91%

Table 3 displays the percentages for each assessment component as follows: display quality is 90.6%, software engineering is 87.5%, media effectiveness is 87.5%, and media use is 100%. Based on the calculation of the feasibility percentage, it can be determined that the overall assessment aspect is 91%, indicating that it is highly practical. Several enhancements have been implemented based on feedback from media professionals. These include modifying the chat menu by incorporating buttons, allowing users to not only utilize buttons but also input sub-materials through the conversation column. Subsequently, enhance the clarity and detail of the visual elements. This enhancement involves enhancing the quality of some photographs that still require clarification. Subsequently, it is necessary to optimize the dimensions of the media and test its compatibility across many devices. The objective is to guarantee optimal visibility and legibility of media content across different devices. Media specialists do adjustments to ensure that the learning media aligns with the media assessment standards. Thorn in Gunawan and Ritonga (2019) posits that interactive media should possess navigational simplicity, cognitive support, skill integration, and prioritize both aesthetics and program functionality.

Table 5. Results of Material Validation Test

No	Evaluation Components	Scores	Maximum Score	Percentage of Eligibility
1	Material Presentation	24	28	85,7 %
2	Precision of Content	13	16	81,3 %
3	Language Usage	8	8	100 %
	Total Scores	45	52	86,5%

According Table 5, the evaluation by material specialists indicates that the element of material presentation has a score of 85.7%, material accuracy has a score of 81.3%, and language use has a perfect score of 100%. Based on the calculation of the feasibility percentage, the overall assessment aspect is determined to be 86.5%, falling within the highly feasible category. Based on feedback from material experts, several improvements were implemented. These included replacing inadequate images, such as those depicting meristem tissue, xylem, velamen, and various parenchymal tissues. Additionally, the size of images depicting epidermis tissue, roots, stems, and leaves of dicots and monocots was enhanced. Labels were also added to microscope photos of stomata, trichomes, and ground tissue. Furthermore, pictures of cork tissue, various types of parenchymal tissue, and illustrations explaining the characteristics of collenchyma and sclerenchyma were included in the relevant section. The objective of these enhancements is to ensure that the entirety of the material offered in the learning media is genuinely suitable and facilitates comprehension for students. The primary purpose of learning media is to serve as a comprehensible and accessible educational tool (Cahyadi, 2019).

Following the incorporation of feedback from media and material specialists, the subsequent step entailed conducting a small-scale trial involving ten students. Table 6 displays the data on student replies.

Table 6. Analysis of Student Responses Test Results

No	Evaluation Components	Scores	Maximum Score	Percentage of Eligibility
1	Media Attraction	115	120	95,8 %
2	Clarity	154	160	96,3 %
3	Display of media	120	120	100 %
4	Utilization of media	80	80	100%
	Total Scores	469	480	97,7%

According to Table 6, the combined evaluation of 10 students for the appeal of the media was 95.8%, the level of comprehension was 96.3%, the visual quality of the media was 100%, and the effectiveness of the media was also 100%. Based on the calculation of the feasibility percentage, the overall assessment aspect is determined to be 97.7%, placing it in the highly feasible group. All pupils in the comments area provided favourable feedback regarding the appearance and features showcased. These comments praise the learning media for being excellent, enjoyable, amusing, and captivating. The learning media is highly beneficial for educational purposes, as it is comprehensive, well-organized, and visually appealing. The features of the learning media are impressive and user-friendly. The inclusion of pictures and videos aids in better comprehension of the material. The evaluation aspect is particularly intriguing, as some assessments are presented in the form of games. Additionally, the learning media is easily accessible through a single website. Nevertheless, students provided recommendations regarding other photographs that required further elucidation. Hence, prior to doing the efficacy assessment, it is imperative to interpret the photographs. Singal et al., (2014) states that the goal is to ensure that the media utilised in the implementation phase effectively meets the students' needs. A key aspect of effective learning media is its ability to be utilised as a tool for learning, both within and outside the classroom. According to Supriatna (2018), learning media should fulfil three primary functions when used for individuals, groups, or large groups of listeners. These functions include: (1) Motivating interest or action, (2) Presenting information, and (3) Giving instructions.

Following the revision stage based on feedback from media experts, material experts, and student answers, the next step is to execute the product by performing extensive trials on a group of 32 students in class XI MIPA 1 at SMA Negeri 4 Tasikmalaya. During this phase, students are administered a pretest and posttest in order to assess their knowledge and understanding before and after utilising the learning media product that is currently being developed. The objective of the test is to evaluate the efficacy of utilising internet chatbot learning media goods on plant tissue material. Table 7 displays the statistical data regarding the pretest and posttest scores.

Table 7. Student Pretest and Posttest Score Statistics

No	Evaluation Components	Value	
		Pretest	Posttest
1	Number of subjects	32	32
2	Highest score	70	97
3	Lowest score	33	80
	Rata-rata	52,6	89

Table 7 reveals that out of the 32 students, the lowest pretest score was 33, the highest was 70, and the average was 52.6. Similarly, for the posttest score, the lowest was 80, the highest was 97, and the average was 89. According to Table 6, it can be inferred that there is a rise in student learning results while utilising online chatbot learning media for plant tissue material, both before and after.

The data analysis, including the normality test and the N-gain test, indicates that the average gain value achieved is 0.77. The value is subsequently analysed and assigned a score based on the n-gain criterion table developed by Meltzer & David in Kurniawan & Hidayah (2020) study, as presented in Table 2. The analysis indicates that the gain value falls inside the high range, since it exceeds 0.7. These results indicate that the usage of website chatbot learning media goods on plant tissue material is highly successful as a learning tool.

4. Discussion

In addition, addressing the issue of educators who perceive certain aspects of the content as challenging to elucidate thoroughly through conventional teaching methods such as PowerPoint presentations or textbooks, the website chatbot learning media product devised in this study serves as a means to surmount this predicament. In addition to being supported by study findings that demonstrate the favourable evaluation, high efficacy, and positive student feedback towards website chatbot learning media, the utilisation of technology-based learning media has also become a necessity (Suminar, 2019).

Traditional learning methodologies have been compelled to transition to digital-based learning (Haleem et al., 2022; Nugraha et al., 2022). Hence, the outcome of this study is the creation of technology-driven educational tools called chatbots. Chatbots, being a form of artificial intelligence, are widely recognised for their ability to enhance learning experiences. Typically, educational chatbots are designed with multimedia features that are visually appealing and engaging for users. When utilised, it has the ability to captivate students' attention. Another benefit is in its convenient and ubiquitous accessibility (Ryong et al., 2023). The chatbot developed in this research is aimed to maximise its appeal by incorporating relevant visuals and videos. Subsequently, visitors can access the media by choosing a sub-material using the navigation button and conversation column. The chatbot can be conveniently accessed using web browsers. In addition, the chatbot product in this study has undergone multiple rounds of refinement in order to ensure that the final product effectively aids teachers in delivering educational content.

5. Conclusions

This project utilises the ADDIE methodology to construct website chatbot learning media for plant tissue material. The ADDIE paradigm consists of five distinct stages: analysis, design, development, implementation, and evaluation. Based on the validation test results, the assessment by media experts achieved a score of 91%, indicating a high level of feasibility. Similarly, the assessment by material experts received a score of 86.5%, also indicating a high level of feasibility. Furthermore, the assessment based on user responses obtained a score of 97.7%, further confirming its high feasibility. Moreover, based on the results of the efficacy test, it is evident that the t-test yielded a Sig value (2-tailed) of 0.000, which is less than 0.05. This indicates a considerable disparity between the pretest and post-test scores. The website chatbot learning media on plant tissue material is highly practicable and remarkably effective for use as a learning medium, as indicated by the average gain value of 0.77.

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