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AHP Learning Website Development with The RAD Method for Deaf Student

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Abstract— The learning target is to implement character education that is integrated with technology so that it can improve the quality of human resources. Learning using the website can be used for students, especially deaf students because learning is fun and there is a high element of creativity that makes it easier to remember learning material. This shows that education is starting to realize the need for a website to increase effectiveness and efficiency, especially for deaf students. This study develops a website-based learning application for deaf students. The material raised is AHP (Analytical Hierarchy Process) in the course of forecasting techniques. The material was chosen because based on a previous survey if the course is one of the subjects that is quite difficult. The application development method uses Rapid Application Development. The trial was conducted on media and material experts as well as 6 deaf students. Both trials produced good test results and were included in the valid and very good categories. Website-based applications do not get major revisions. Thus, this application is feasible to use.

Keywords— website, media, learning, deaf students

I. INTRODUCTION

The world of education today requires information technology for the distribution of information, especially in the context of integrated creative, innovative, and affective-oriented learning [1]. The learning target is implementing integrated character education to improve the quality of human resources [2]. One of them is learning by using internet-based websites according to data released by Exbytes Indonesia that there is an increase of 168% for websites for education until March 2021. The increase in learning using websites has increased significantly compared to 2019-2020 [3].

Based on data from the Central Statistics Agency in 2019 and 2020, the number of deaf people (deaf) in Malang City has increased from 50 deaf people in 2019 and 136 deaf people in 2020, meaning an increase of 86 deaf people or an increase of more than 100%. Details for 2020 are Kedungkandang sub-district with 27 deaf, Sukun sub-district with 47 deaf, Klojen sub-district with 9 deaf, Blimbing sub-district with 25 deaf, and Lowokwaru sub-district with 28 deaf. So that improvement of learning services, especially for the deaf, must be further improved.

Website-based learning tools are useful for students and lecturers because (1) they can help students to deepen and engage in learning materials; (2) can learn by not depending on others and without knowing where they are; (3) can support teachers in conducting an interactive learning process; and (4) can help advance the quality of teaching in schools [4]. Although website-based learning has good educational

benefits, not many people use it because there are still few who understand the use of websites. While one of the learning media that can be used is website-based learning media.

Learning using the website can be used for students, especially deaf students because learning is fun and there is a high element of creativity that makes it easier to remember learning material. This shows that education is starting to realize the need for a website to increase effectiveness and efficiency, especially for deaf students. So the website needs to be used and the manufacturing process adjusted to the capacity, goals, target visitors, and needs. Websites are growing because the world of web development has become an object with great potential for the world of education. One of the website-based learning that is currently needed is AHP learning because according to Abdelnabi [5] it becomes a necessity in the digital era in the process of delivering learning. In addition, website-based media can also be a medium that can be learned so that everyone can develop their media. Website-based learning makes learning fun and there is a high element of creativity because it uses the website as a medium in the learning process. Especially users who are deaf students whose learning process is not the same as normal humans. The teacher will display the lecture material using an internet browser and it can be done anywhere.

The phenomenon that has occurred so far is that there are obstacles for teachers when delivering materials and illustrations to deaf students about AHP learning through verbal communication. Moreover, learning is currently carried out in a hybrid manner, namely 50% offline learning and 50% online learning. This raises new problems for lecturers who provide material for deaf student communicating during learning who may not necessarily be able to communicate using sign language. So it is necessary to develop digital-based learning innovations with web-based and effective real-analysis learning models [6]. Based on the analysis of the existing phenomena and problems, it is necessary to have the necessary solutions for the learning process for deaf students by utilizing technology and web-based learning media which is a transformation process towards digital. The change from listening to the material delivered by the teacher turns to observing, doing, and implementing the AHP learning process with easier and more flexible access ranges [7].

Rapid Application Development (RAD) is one of the relatively fast methods in the development of assistive technology to develop prototyping methods by involving users in developing applications on an ongoing basis. The RAD method is a method to produce a high-quality and accurate system [8]–[10]. According to Mandang, et al. [11], RAD can produce systems faster to reduce the time for redevelopment after the implementation phase.

Based on the description above, this research designs AHP learning by developing a website that converts voice into text features on laptops and cellphones quickly and accurately during the learning process. The development of the AHP learning website is one of the effective means to introduce AHP material, especially to deaf students. Through assistive technology, students with deafness can learn AHP more easily without having to use sign language and can participate in learning more easily. This application is not only a learning medium but actually, can also be used as a communication tool. So that this application falls into the category of communication media and learning media.

II. RAPID APPLICATION DEVELOPMENT (RAD)

This section describes how the system design process uses the RAD method. Web-based applications are applications that are accessed via the internet and are software built using HTML, JavaScript, CSS, PHP, and other programming languages. One of the advantages of website development is that it can be accessed through the platform and information presented by a web browser. In addition, it is part of the System Development Life Cycle (SDLC) with an emphasis on development that is carried out in a short time and iterative method [12]–[14].



Fig. 1. Stages of the RAD Approach [15].

Rapid Application Development (RAD) is a prototyping method by involving users in continuous application development until a new system is presented. In addition, application development takes 30-90 days so that the process is faster and able to produce quality products. The RAD method uses four development phases.

A. Requirement Planning Phase

The requirements planning phase is the determination of the goals and needs of data and information. At this stage there was a problem with the results of the researcher's observations, namely there were students during the implementation of the programming technique lectures who could not follow properly because they were included in the category of Deaf students. The problem is described by linking advances in information technology by integrating voice commands into text with AHP materials and applications.

B. RAD Design Workshop

The RAD design workshop is a work phase that prioritizes collaboration between application developers and prospective application users. For this phase to run well, it is necessary to prototype, test, and refine. The website-based application developed has a very simple design to use. Figure 2 shows the general design results of the website.

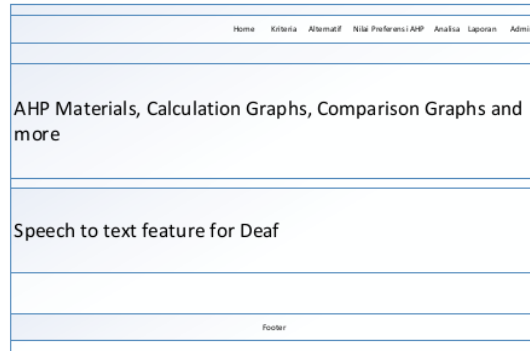


Fig. 2. Website-based application prototype design.

At the testing stage, the application is tested functionally using a Black Box test. Furthermore, a feasibility test was carried out on all Deaf students in the Information Technology Faculty, University of Merdeka Malang, then input was obtained according to the needs of Deaf students.

C. Instruction Phase

The execution phase for scripting the program and showing the platform, software, and hardware used. Furthermore, the analyzer will make changes to each application design according to the instructions from the user. At this stage, the researcher tries to develop an initial prototype of the application so that deaf students can try it first. In its development at this stage, there are no significant obstacles from the side of researchers and deaf students.

D. Implementation Phase

The implementation phase includes programmers, human interface designers, and systems analysts. The implementation phase is a system that is ready to be used by users and evaluated. Testing is carried out during lecture activities. Students and lecturers together practice teaching using a website-based application. Previously, the application had been installed on the student's computer and the mic was installed on the lecturer's. When the lecturer explains the material, the sentences spoken by the lecturer will automatically be written on the deaf student's computer. So that students can read and understand what is conveyed by the lecturer. Figure 3 shows the learning process using a website-based application for Deaf students.

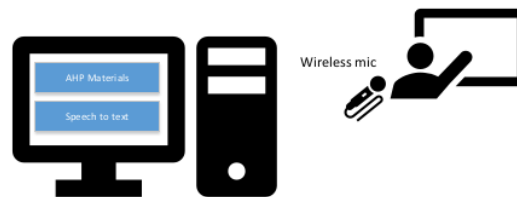


Fig. 3. The learning process using a website-based application.

Figure 3 provides an illustration of how the teaching process in a class with deaf students. The way of learning is obtained from the results of a fairly long experiment starting from previous studies that have been carried out by the research team. It also cannot be separated from the role of lecturers and non-deaf students who care about deaf students.

The research team and students often discuss how to effectively conduct lecture activities with deaf students in class. Figure 3 illustrates if the application has been opened or installed on a deaf student's computer. Lecturers with wireless mics carry out learning as usual and deaf students can see the results of the voice-to-text conversion and immediately practice the instructions given by the lecturer.

E. Validation Process

Creating indicators utilizing The Attributes of Instructional Materials [16] to assess the website and fill out validation questionnaires the researchers derived indications from various sources, which are depicted in Table 1.

TABLE I. INDICATORS BASED ON THE CHARACTERISTICS OF EDUCATIONAL CONTENT

Subject	Indicators	Number of sub-indicators
Media Expert	Media Display	5
	Media in Learning	3
	Student involvement in the use of media	2
Material Expert	Fit of Purpose	4
	Content	2
	Interaction	1
Deaf Student	Media interest	2
	Media operation	1
	Benefits	3
	Enthusiastic	1

The utilized scale's filling relates to the Likert scale. Because it is simpler to use and do additional analysis, the Likert scale was used [17], [18]. Additionally, it is simpler for test participants to complete a questionnaire using a Likert scale since they just need to check or fill in by choosing from a range of 1 to 5 under the given parameters. Table 2 shows the level of validity and feasibility of qualifying an application [19].

TABLE II. THE DEGREE OF APPLICATION QUALIFICATION VALIDITY AND FEASIBILITY

Score in percent (%)	Eligibility Category	Notes
81 – 100	Very valid, Very good	No need to revise
61 – 80	Valid, Well	Revised as necessary
41 – 60	Valid enough, Pretty good	Minor revision
21 – 40	Less valid, Not good	Major revision
0 – 20	Invalid, Very less	Total revision

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III. RESULT AND DISCUSSION

This section describes how the result of developing learning applications using the Rapid Application Development method. This section is divided into three parts with the addition of one discussion section related to the results of application trials both functionally and trials to students with deaf disabilities.

The website-based learning application trial was conducted on 6 deaf students at the Faculty of Information Technology, Universitas Merdeka Malang. The trial was carried out after the researcher tested the functionality using the Black Box testing on the researcher himself and deaf students before the system developed met expectations.

A. Application Development Results

This section is the result of the implementation steps of the Rapid Application Development method. Figure 4 shows the results of developing the criteria page on AHP which is equipped with a voice-to-text converter script. It is believed that researchers can make it easier for Deaf students to understand and simplify the process of learning the AHP method in Forecasting Engineering courses.

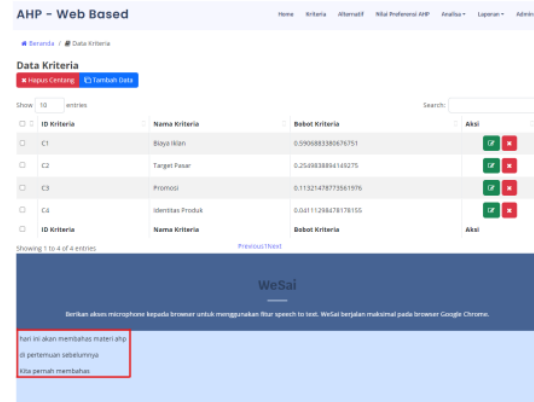


Fig. 4. The criteria page contains the voice-to-text converter feature.

On each page of the AHP application above, there is a section that converts sound to text. So that deaf students can follow every activity carried out by the lecturer. The results of the implementation are also made user-friendly so that they can also be opened from the cellphones of deaf students. Figure 5 shows an overview of the explanation of the previous sentence.

For now, the website-based AHP learning application on the voice-to-text feature uses Indonesian only. This is because the existing Deaf students all use BISINDO (Indonesian Sign Language). Simply put, BISINDO is practiced using 2 hands [20].



Fig. 5. Home page of a mobile phone that also has a voice-to-text converter feature.

B. Test Functionality with Black Box

The Black Box test [21] is a test that is carried out based on the functionality and appearance of the interface when the program is run by the user. Tests are carried out to check and ensure that the components function as expected. Testing needs to be done to find errors that may still occur. Tests are carried out to observe the input and output results of the software without knowing the code structure of the software. There is no specific guidance on test cases because the test cases in the black box test are based on the functionality of a web-based AHP application for deaf students. So, what is being tested is related to usability to display as it should. Table 3 shows the results of the Black Box test.

TABLE III. TESTING USING BLACK BOX

No	Test and Result		
	Case Tested	Expected	Result
1.	LOGIN button on the login page	The system can enter the Dashboard page, once selected	Succeed
2.	Dashboard button on the navigation bar	The system can enter the Dashboard page, once selected	Succeed
3.	Criteria button on the Dashboard page	The system can view the data on the Criteria page	Succeed
4.	Add the Data button on the Criteria page	The system can display the new criteria-filling form	Succeed
5.	Clear Data button on the Criteria page	The system can delete the selected Criteria	Succeed
6.	Alternate Button on the Dashboard page	The system can view the data on the Alternatives page	Succeed
7.	Add the Data button on the Alternatives page	The system can display a new alternative filling form	Succeed
8.	Clear Data button on the Alternatives page	The system can delete the selected Alternative	Succeed

No	Test and Result		
	Case Tested	Expected	Result
9.	AHP Preference Value Button on the Dashboard page	The system can view the data on the AHP Preference Values page	Succeed
10.	Add Data button on AHP Preference Values page	The system can display the AHP preference value filling the form	Succeed
11.	Clear Data button on the AHP Preference Values page	The system can delete the selected AHP Preference Value	Succeed
12.	Criteria Analysis button on the page	The system can view the data on the Criteria Analysis page	Succeed
13.	Alternative Analysis button on the Dashboard page	The system can view the data on the Alternative Analysis page	Succeed
14.	Rank Report button on the Dashboard page	The system can view the data on the Ranking Report page	Succeed
15.	Report button on the Dashboard page	The system can view the data on the Report page	Succeed
16.	Logout button on the Dashboard page	The system can terminate the user session	Succeed

Functionality testing in Table 3 shows that the results of tests carried out by both researchers and deaf students functionally have no significant problems. The RAD method involves the user directly in system development so that in the black box testing process the research team involved one deaf student to also try out applications that had been developed before limited trials. This makes system development relatively faster. The system as a whole is ready for further testing on all deaf students.

One of the suggestions regarding the functionality of the website application given by the test team in which there are Deaf students is that the size of the text in the translation section is slightly larger. At the time of the interview, the reason was that the understanding of Deaf students was different from normal students. Deaf students understand sentences usually based on the meaning in whole sentences, not per word in sentence structure. This results in the lecturer giving an explanation having to be a little slower when explaining.

C. Limited Trial and Discussions

In this section, validation is carried out on media and material experts as well as testing on 6 deaf students at the Faculty of Information Technology, Universitas Merdeka Malang. The trial was carried out during the learning process. Testing is done on a limited basis because the system is still in the development stage. This application will continue to receive improvements as the lecture ends in January 2023. Table 4 shows the results of the validation by media and material experts. Table 5 shows the results of the Deaf student trial by filling out a questionnaire after the students tried to operate a website-based learning application.

TABLE IV. ¹ VALIDATION RESULTS BY MEDIA AND MATERIALS EXPERTS

Subject	Indicators	Number of sub-indicators	Average
Media Expert	Media Display	5	4,7
	Media in Learning	3	4,3
	Student involvement in the use of media	2	4,1
Material Expert	Fit of Purpose	4	4,2
	Content	2	4,5
	Interaction	1	4,3

Based on table 4, it can be concluded that the overall average is 4.35 or 87%. Thus, it is included in the feasible category without revision with additional suggestions. There are some minor suggestions, but they are not shown in this article because they can be corrected directly by the researcher. As in the previous section, in the development of this website-based application, no major revisions were found so that it is suitable for use during the lecture process.

TABLE V. ¹ TEST RESULTS BY 6 DEAF STUDENTS AT THE FACULTY OF INFORMATION TECHNOLOGY

Subject	Indicators	Number of sub-indicators	Average
Deaf Student	Media interest	2	4
	Media operation	1	3,83
	Benefits	2	4,05
	Enthusiastic	1	4,2

Based on table 5, it can be concluded that the overall average is 4.02 or 80.7% \approx 81%. So it is included in the eligible category without revision. Applications that have been developed can help deaf students understand the material. In the context of interest in the subject, with this media students are more interested in learning. In addition, students are certain to also have the advantage of using computer devices in the learning process, so that more experience is obtained in the learning process. This is in line with research conducted by Xueyen Dong [22] was learning by providing opportunities for students to try themselves can improve their understanding of the material provided. Similar research also found the same thing providing experience in trying the application of learning media can cause the effect of liking and being interested in the lesson being studied [23], [24].

Student interest in website-based learning is also seen in research conducted by Salam [25] which shows that students' motivation in learning increases with the use of website media. This means that students' psychomotor abilities will be honed and affectively students have more curiosity to improve their ability to understand the material. Similar research also produces the same feedback. The use of website-based learning applications also makes it easier for lecturers to provide material and can be updated quickly and accurately [26].

Furthermore, this research illustrates that education today must refer to inclusive education. Inclusive education that can accommodate all types of students. Inclusive education here

⁶ includes in terms of curriculum, educational infrastructure, and learning systems that are tailored to the individual needs of students [20], [27], [28]. The Faculty of Information Technology, Universitas Merdeka Malang, started by creating an MVTe (Mobile Voice to Text) application in 2021 to support the creation of a smooth communication atmosphere between deaf students and others [10]. But in practice at that time, it was not optimal because the application was still limited to the Android operating system. In 2022, FTI seeks to cover this shortfall by creating a website-based translation application. Thus, ¹⁹ research team made efforts to provide adequate facilities so that teaching and learning activities can be fulfilled for inclusive education. In line with previous research on learning media for deaf students, it was concluded that the media was able to stimulate deaf students to better understand the material [29]. This is because deaf students rely on vision and literacy skills in understanding the material [30].

IV. CONCLUSION

The research succeeded in making learning applications for AHP material in the website-based decision support system course. For now, the application is still installed on localhost in the laboratory of the Faculty of Information Technology. Effectiveness research is still ongoing until the end of 2022 so it has not been produced on the website. Website-based learning applications get valid categories fit ¹⁷ media experts and material experts. Meanwhile, from the user's point of view, namely Deaf students, the results of the application trial are include ¹ in the very good category without any revisions. So that the website-based AHP application is included in the appropriate category for use in the learning process.

Further development of this application can be done for applications based on Android and iOS so that it reaches all mobile devices. Other developments are not limited to AHP material in forecasting engineering courses. Other researchers can try to develop similar applications with different methods. Thus, there will be many similar applications with different methods.

For campuses that have students with special needs, to create inclusive learning, this kind of application is needed according to the needs of students. Thus, at least in terms of learning, all students with any conditions get the same opportunities and knowledge. The problem of acceptance of learning is already a different matter. As a form of effort to realize inclusive education, efforts are needed to develop learning support applications to produce appropriate learning methods.

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