Designing learning materials of Indonesian language course based on augmented reality and interactive website for blind students

(Merancang materi pembelajaran bahasa Indonesia berbasis augmented reality dan website interaktif untuk siswa tunanetra)

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Abstract: Indonesian language is a compulsory subject in university level. This subject has been taken by all Indonesian university students with or without disabilities. This study aimed to design Indonesian Language course based on Augmented Reality (AR) and interactive website that were adapted for blind students. This study was developmental research using ADDIE model. The subjects of this study were students with disabilities in private universities at East Java, Indonesia. Result of study showed that in analysis stage there were five things needed by disability students. In the design stage, flowchart and storyboard were made. In the developmental stage, website structures were built using WordPress; while Augmented Reality was designed using Unity platform. In the implementation stage, limited and extensive trial tests were conducted. In the evaluation stage, there were two main activities. First, students were given tests. Second, product was revised. Conclusion of this study was learning materials of Indonesian language course could be developed by implementing ADDIE model, so it could be used by blind students.

| Keywords | Augmented reality, Learning materials, Indonesian language, Blind students, Interactive website |

Abstrak: Mata kuliah bahasa Indonesia sebagai mata kuliah wajib di perguruan tinggi. Mata kuliah ini wajib diambil oleh semua mahasiswa di Indonesia saat kuliah, baik mahasiswa tidak disabilitasi atau mahasiswa disabilitas. Oleh karena itu tujuan penelitian ini adalah untuk merancang bahan ajar mata kuliah Bahasa Indonesia berbasis Augmented Reality (AR) dan website interaktif yang diadaptasi khusus untuk mahasiswa disabilitas khususnya tunanetra. Penelitian ini termasuk penelitian pengembangan dengan memanfaatkan model ADDIE. Subjek penelitian adalah mahasiswa disabilitas di perguruan tinggi swasta di Jawa Timur. Hasil penelitian menunjukkan bahwa pada langkah analysis ditemukan lima kebutuhan yang dibutuhkan oleh mahasiswa. Pada langkah desain yaitu menyusun flowchart dan menyusun storyboard. Pada langkah development yaitu membangun struktur website dengan platform yang dipilih adalah WordPress sedangkan Augmented reality didesain dengan menggunakan platform Unity. Pada tahap implementation melibatkan uji coba terbatas dan uji coba luas. Pada tahap evaluation ada dua kegiatan utama, pertama memberikan tes kepada mahasiswa, kedua melakukan revisi produk. Simpulan penelitian ini adalah bahan ajar mata kuliah Bahasa Indonesia dapat dikembangkan dengan menerapkan model ADDIE sehingga dapat digunakan oleh mahasiswa tunanetra.

| Kata Kunci | Augmented reality, Bahan ajar, Bahasa Indonesia, Mahasiswa tunanetra, Website interaktif |

INTRODUCTION

Students with disabilities are studying under inadequate conditions. Disability is a condition which is not only related to physical or mental disabilities caused by medical conditions; however, it is also related to how a person lives in a social environment (Altman, 2014). Kendall (2016) states that this is a condition of physical and mental limitations that cause a negative impact on individual's ability to live in social environment. The same situation happens to students with disabilities. They need a university role in providing facilities for them (Kondo et al., 2015).

Students with disabilities have different characteristics compared to non-disabled students. Several experts, such as O'Shea & Meyer (2016) explain that the characteristics which are difficult to observe are difficulties in learning and controlling their attention, while physical disabilities are often encountered and can be observed easily. Moreover, the characteristics of students with disabilities can be observed based on the differences in their academic abilities, their responses to their surroundings, and results of their medical examinations (Maki et al., 2017). In addition, students with disabilities tend to need more social support to reduce mental depression about their limitations (Jensen et al., 2014). This research focuses on the blind students.

Those conditions make most disabled students including the blinds have various obstacles and difficulties in teaching and learning process compared to non-disabled students. University provides opportunities for students with disabilities to obtain qualifications and facilitates them to build their personal and group identities (Riddell & Weedon, 2014). However, inadequate access in learning process makes students with disabilities lagged far behind in university level (Witham & Brewer, 2023). The accessibility problems lead to various learning systems that give less support for disabled students, such as learning materials that make the interaction between disabled students, non-disabled students, and lecturers to be not effective (Vlachou, & Papananou, 2015).

Learning materials have a crucial role in the students' development and learning objectives to be achieved. Learning materials are used to convey and present a theme to help students understand (Skoufaki & Petrić, 2021). It is an important part of educational progress (Hasanudin et al., 2022) in facilitating students to obtain information and materials (Nugroho. 2019), master the expected competences (Rahmayantis & Nurlailiyah, 2021), and improve their understanding about it (Rahman et al., 2024). It can be said that learning materials are utilized by teachers to ensure that students understand the materials and they obtain the best learning outcomes (Zulaeha et al., 2023).

Based on previous explanations, it can be understood that the use of learning materials in the teaching and learning process provides many advantages for educators (teachers) and students. Several studies, such as Nieto-Márquez et al., (2020) reveal that learning materials is a key of feedback in learning process because it helps students to make decision and understand the materials. It also facilitates teachers in conveying materials to be simple and easy to be understood (Aydin & Aytekin, 2018). It drives teachers to create better learning opportunities (Puspitoningrum, 2015). Therefore, learning materials are able to encourage students' motivation (Puspitoningrum & Rahmayantis, 2018), potentials (Eriyanti, 2017), and increase their abilities in teaching and learning process (Syahrizal et al., 2024).

There are various learning materials which can be used in the teaching and learning process, such as printed books that have been packaged with materials that are used for many subjects (Garton & Graves, 2014). Books are included in the type of printed learning materials which can boost students' intention and motivation in understanding it (Mayembe & Nsabata, 2020). Moreover, there are digital learning materials that can be used such as digital library, e-book, and other e-learning sources (Alenezi, 2020). However, the implementation of printed and digital learning materials in university level gets obstacles because it has not fully considered important aspects (Rahmi & Azrul, 2021). This can be clearly viewed that students with disabilities are often neglected in various courses, especially general courses which prevent them from enjoying and using the learning materials optimally.

One of general courses which becomes a compulsory subject for Indonesian university students is Indonesian language course (Ali & Siddiq, 2022). This course teaches students good and

effective communication skill by considering various language skills such as listening, writing, speaking, and reading (Herawati et al., 2021). Moreover, Maharany et al. (2022) explain that Indonesian language has become a personality development course presented for university students by considering the rules of each study program. In other words, all university students including disabled students have the right to take Indonesian language course and receive proper learning facilities.

Teaching Indonesian language course in university is very important because it teaches basic skill for students, such as reasoning skill and academic writing (Sitepu, 2019). This course also provides dual functions, namely national symbol and identity, so the students understand the way to respect the unity in Indonesia and become the part of Indonesian unity (Sanulita et al., 2024). It is very crucial because Indonesian language is used by students to communicate and discuss many things in social environments, work environments, or daily lifes (Siahaan & Saragih, 2021). It is very important for teachers/lecturers to ensure that this course has been well understood by students especially the disabled students.

It is too bad because the teaching process of Indonesian language course in several universities gets many obstacles, such as the lecturers cannot find interesting teaching ways to share materials, the learning process is boring, and other obstacles which make students' learning outcomes of this course is not optimal (Darmuki et al., 2023). Fatmawati et al., (2023) state that teaching Indonesian language course in university provides less innovation because most of it focuses on the learning process by memorizing and reading printed books, so the students cannot be actively involved in it. Cahyana et al., (2020) argue that this condition is caused by the absence of Indonesian learning sources that are used to meet the students' needs, including the needs of disabled students. Therefore, an innovation is needed to develop the learning materials of Indonesian language course to fulfill the students' needs to make them actively involved in the learning process and obtain the best results.

The teaching material development that can be done in Indonesian language course is by using interactive website. This website is present through internet or digital sites on the WWW (World Wide Web) that can develop data, so it can be displayed more attractively and accessed easily (Ferdiansyah & Irfan, 2021). Wahyuni et al., (2024) explain that interactive websites as online site can be arranged to create learning materials, so it can help students to explore more knowledge than printed books that are limited. Using websites makes teachers to present more interactive learning materials to create unlimited interactions with students; it also facilitates students to use technology (Mardianti et al., 2023).

However, the use of interactive website cannot fully help students, especially disabled students, in understanding materials. Other integration is needed to make the learning materials can be suitable for all students. This is because interactive websites can only contain simple forms of writing, pictures, videos, or combination of it (Halimatusyadiah & Disman, 2023). Pahamzah et al., (2022) suggest that in developing materials using interactive websites, the lecturers have to consider the students' needs to create good learning materials. One of the latest integrations in digital learning or interactive website is the use of Augmented Reality (Chao & Chang, 2018).

Akçayır (2017) state that Augmented Reality (AR) is a technology which can bring virtual objects to be real. In other words, Augmented Reality is a tool to visualize an object created through technology as a virtual component which is displayed as the real object (Thees et al., 2020). Alzahrani (2020) also says that AR is an extraordinary field of computer graphics which can be implemented in various fields, including educational fields. It can be said that AR can be interpreted as technology in computer graphics which is used to visualize virtual objects to be real.

The implementation of AR in education is used to create learning materials which help students with disabilities in understanding materials and obtaining memorable learning experiences. Cai et al., (2021) reveal that AR can change educational field because it can make abstract materials to be interactive through the material presentations that can be seen, heard, or felt. Hamzah et al., (2021) state that AR can optimize sensory ability because it improves students' experiences in which physical and digital objects coexist. Furthermore, Tuli & Mantri (2021) explain that AR can be used to create more interactive learning materials, so it can be easily understood, consistent and suitable for all

students. It is very appropriate to be used as learning materials to facilitate students with disabilities in the teaching and learning process.

On the other hand, learning materials which are packaged using interactive website can be used to fulfill the needs of disabled students. A study conducted by Salvador-Ullauri et al., (2020) implements interactive website to ensure disabled students can access and understand the materials, so it becomes a new solution in education. The learning material in that study is developed using websites in the form of games. The teachers can ensure that students with disabilities can use their cognitive, motor, and sensory skills optimally. However, it is stated in the study that it still needs assistive technology to achieve maximum access for disabled students. Furthermore, the study focuses on discussion of games developed using websites, without providing further explanation about the subject or course.

The need for more sophisticated technology can be met with Augmented Reality. In line with Rodríguez et al., (2021) who discuss about the use of AR in interactive website to help teachers in sharing the materials. It focuses on the implementation of MoleculARweb as an interactive website developed using AR. MoleculARweb is learning material in website using AR to visualize molecular material. By combining interactive website and AR, MoleculARweb can help students to manipulate the data and move molecular objects. It makes 82% of research subjects feel helped in understanding the learning materials. However, it has not explained whether this learning material can facilitate disabled students or not. In addition, MoleculARweb only focuses on chemistry course, not the general course such as Indonesian language course.

Moreover, the study conducted by Jdaitawi & Kan'an (2022) has proven that AR is useful for students with disabilities. The use of AR provides positive learning outcomes for disabled students because the learning materials have great contribution to help disabled students to develop their personal skill, social skill, and learning skill. Therefore, the use of AR will be useful for students who have learning disabilities, hearing difficulties, difficulty in seeing, and other disabilities. The research only focuses on the impact of AR on the learning success of disabled students. It has not explained how AR is created into learning process in certain courses.

Based on previous explanations, it can be said that a study on the integration of interactive website and AR is needed to fulfill the needs of disabled students in Indonesian language course. This novelty will bring an innovation for education to help lecturers in presenting learning materials of Indonesian language for students with disabilities. The aim of this study is to develop the learning materials of Indonesian language course based on Augmented Reality and interactive website for students with disabilities especially the blind students.

METHOD
Research Design

This study was developmental research which implemented ADDIE model. In the analysis stage, the researchers determined the students' characteristics and made questionnaire of need analysis. In the design stage, the researchers made a flowchart and storyboard. In the development stage, the researchers created products, conducted eligibility tests of material and media, and revised the product. In the implementation stage, the researchers conducted limited and extensive trial tests. In the evaluation stage, the researchers provided test for students and revised the product. The stages could be viewed in Table 1.

Table 1
Objectives and Activities at Research Stages

	Analysis	Design	Development	Implementation	Evaluation
Objectives	Identifying problems in research subjects	Designing blueprint desired by research subjects	Developing and revising the product desired by research subjects	Implementing developed products to solve problems	Assessing and revising product

Activities	- Determining students' characteristics - Creating questionnaire of need analysis	- Creating flowchart - Creating storyboard	- Creating product - Conducting eligibility test of material - Conducting eligibility test of media	- Conducting limited trial test - Conducting extensive trial test	- Providing test to university students - Revising product

Research Subject

Subjects of this study were disabled students in private universities in East Java (Bojonegoro Regency, Sidoarjo Regency, and Ponorogo Regency). This study focussed on blind students.

Data and Technique in Collecting Data

Data and technique in collecting data in this study followed ADDIE model. It could be viewed in Table 2.

Table 2
Data and Technique in Collecting Data

	Data	Technique in Collecting Data
Analysis	Survey data	Questionnaire and interview
Design	Descriptive or characteristics data	Questionnaire and interview
Development	Design or development data	Questionnaire
Implementation	Survey data	Observation
Evaluation	Test results	Test

Data Analysis Technique

Techniques in analyzing data in analysis stage, design stage, and implementation stage were conducted by implementing qualitative analysis of Miles dan Huberman (2007) using flowchart that consisted of three activities, namely data reduction, data presentation, and drawing conclusion. In the development stage, the data was analyzed using descriptive statistical analysis. This statistical analysis was carried out by converting data into percentage form using the following formula.

$$P = \frac{x}{xi} \, X \, 100$$

In which:
P = Percentage of each criteria
x = Score of each criteria
xi = Maximum score of each criteria

Result values of P were matched in Table 3 to determine the criteria of eligible learning materials.

Table 3
Eligible Criteria of Learning Material

Skala (%)	Eligible Criteria
85 – 100	Eligible with very good predicate
65 – 84	Eligible with good predicate
45 – 64	Eligible with sufficient predicate
0 – 44	Not eligible

(Ministry of National Education, 2008)

Material and media experts could provide criticism, suggestions, and comments in the provided column. The data in the form of experts' criticism, suggestions, and comments were qualitative data. These data were processed using descriptive data analysis. It was conducted by

grouping and describing qualitative information obtained from the expert's validation sheet. Results of analysis were used to conduct further revision.

In evaluation stage, it implemented pretest and posttest design by using a mean similarity test of t-test. The researchers wanted to investigate whether there was significant influence on the use of learning materials of Indonesian language course based on Augmented Reality and interactive website to increase students' learning outcomes.

Data Validation Technique

In the analysis stage, the researchers used triangulation method. The researchers used questionnaires and interview to obtain consistent students' responses. In design stage, the researchers used triangulation of data source. They compared and verified the questionnaire results from students to obtain more accurate information. In the development stage, the researchers used triangulation methods. They used questionnaire and interviews to determine whether the responses of material and media experts were consistent or not. In the evaluation stage, the researchers used Pearson product moment test. The researchers wanted to investigate whether there was a statistically significant relationship between two variables. In addition, this test determined whether the relationship was positive or negative.

RESULTS AND DISCUSSION

Designing learning materials of Indonesian language course based on Augmented Reality and interactive website for students with disabilities used the stages of ADDIE. Those five stages could be explained as followed.

Analysis Stage in Designing Learning Materials of Indonesian Language Course

In analysis stage, the researchers conducted need analysis of learning materials in Indonesian language course. This need analysis involved students with disabilities in IKIP PGRI Bojonegoro. It was conducted using a questionnaire. The result of questionnaire could be explained as followed.

First question was "*Sesuai perkembangan ilmu pengetahuan dan teknologi, menurut saudara bahan ajar mata kuliah bahasa Indonesia masih perlu dikembangkan?* [In line with science and technology development, do you think that learning materials of Indonesian language course need to be developed?]". The students'responses could be viewed in Figure 1.
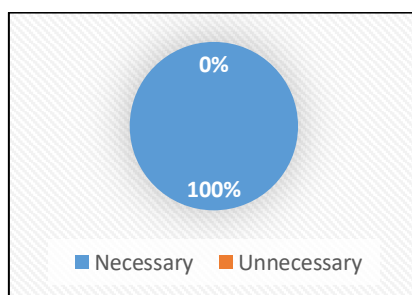

Figure 1
Students' Responses in Question 1

In Figure 1, it could be explained that all students needed learning materials of Indonesian language course which followed the science and technology development.

Second question was "*Untuk menghasilkan kompetensi yang lebih baik, menurut saudara bahan ajar mata kuliah bahasa Indonesia perlu memuat unsur apa saja?* [In your opinion, to create better competence, what elements do the learning materials need to contain?]". The students' responses could be viewed in Figure 2.
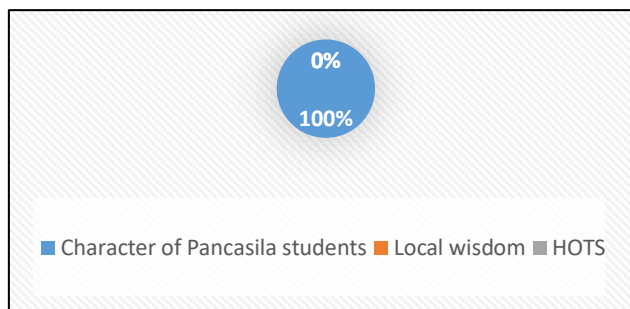
Figure 2
Students' Responses in Question 2

In Figure 2, it could be explained that all students wanted the element of students Pancasila profile in Indonesian language course.

Third question was "*Untuk mengakomodir pembelajaran era society 5.0, menurut saudara bahan ajar mata kuliah bahasa Indonesia dapat dikemas dalam bentuk apa?* [In your opinion, to accommodate learning in the era society 5.0, teaching materials of Indonesian language course can be packaged into?]". The students' responses could be viewed in Figure 3.
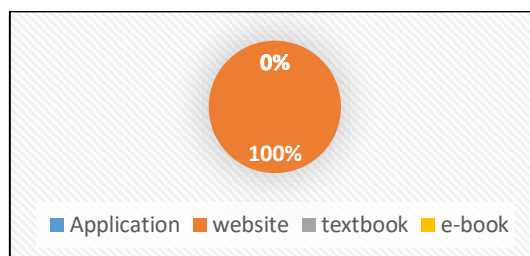
Figure 3
Students' Responses in Question 3

In Figure 3, it could be explained that all students were agree that website was a form of learning materials for Indonesian language course.

Fourth question was "*Dalam konteks pencegahan perundungan dan pelecehan seksual untuk mensimulasikan situasi-situasi yang realistis di lingkungan kampus, menurut saudara apa yang dibutuhkan di dalam bahan ajar mata kuliah bahasa Indonesia?* [In your opinion, to prevent bullying and sexual harassement in stimulating realistic situations in the campus, what do you need in teaching materials for Indonesian language course?]". The students' responses could be viewed in Figure 4.
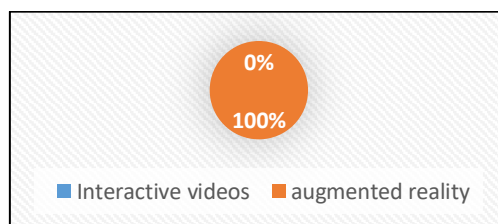

Figure 4
Students' Responses in Question 4

In Figure 4, it could be explained that all students wanted the element of Augmented Reality in the teaching materials of Indonesian language course.

Fifth question was "*Bentuk tampilan menu pada website yang seperti apa yang saudara inginkan?* [What kind of menu display do you want on the website?]". The students' responses could be viewed in Figure 5.
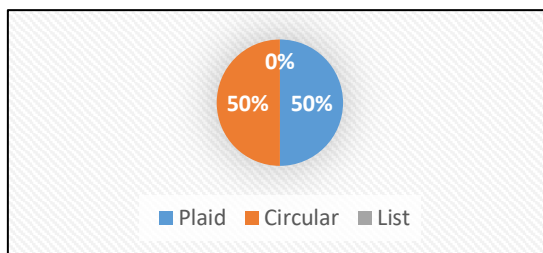
Figure 5
Students' Responses in Question 5

In Figure 5, the percentage of students answering boxes were 50%, the percentage of students answering circles were 50%, and no student answered the list form.

Design Stage in Designing Learning Materials of Indonesian Language Course

The design stage in designing learning materials of Indonesian language course based on Augmented Reality and interactive website was by making flowchart and storyboard. The flowchart of learning material design could be viewed in Figure 6.
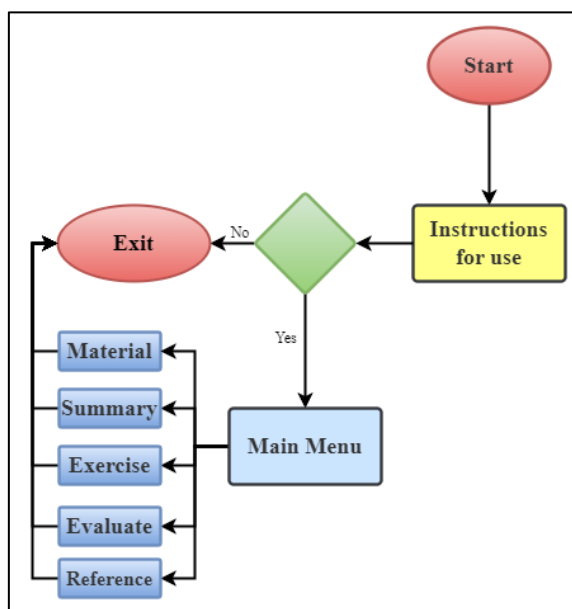

Figure 6
Flowchart of Learning Materials in Indonesian Language Course

After the flowchart was finished, a storyboard was made. The initial storyboard contained the main menu of the website. The homepage contained the website's name, instructions for use, logo, material descriptions, material menu, and developer identity. The homepage was designed using structured and simple main elements. At the top of screen, users would see the website name and logo, followed by brief instructions that could be skipped when it was familiar. Furthermore, the descriptions of learning materials including the learning objectives and significances were presented briefly. It also provided general information about the contents. There were a navigation menu of materials with different topics and additional icons to be understood.

At the bottom of screen, information of developer identity was presented, including teams' names, logo, and official context to provide credibility. Moreover, accessibility features such as font size setting, color contrast, and sound mode were provided to ensure user's comfort with various needs. The overall design focused on ease of navigation and inclusive user experiences. The initial storyboard of the website could be viewed in Figure 7.
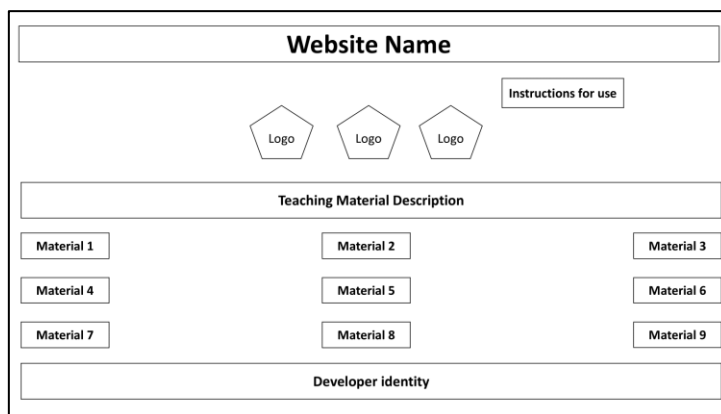
Figure 7
Storyboard of Website Homepage

In the next storyboard, there were sub menu of materials. In top of it, there was the title of material, followed by description. Under the description, there were several sub menus, such as materials, summary, exercise, evaluation, and references. In the left side, there were a video and Augmented Reality menu.

In the storyboard of sub menu material, there was the title of material on top of it to give information to user about the main topic accessed. Under the title, there was a brief description of the material which provided general information about the content would be studied. This description was designed briefly to help users understand the objective and scope of material before proceeding to the next material.

Moreover, there were several sub menus which enabled users to navigate the material. The sub menus included 'Material Menu' to access the main content, 'Summary Menu' containing important points, 'Exercise Menu' containing questions and interactive activities, 'Evaluation Menu' to measure user's understanding, and 'References Menu' to state sources of information. Those sub menus were arranged in logical order to help user in following the structured materials.

On the left side of screen, there were two important menus to support interactive learning experiences. The video made users access visual content which was relevant to the material. The Augmented Reality menu provided access to AR features in which the users were able to see 3D simulation model which supported them to understand the materials. The placement of both menus on the left side aimed to provide quick and easy access to the interactive elements. The storyboard of the material's sub menu could be viewed in Figure 8.
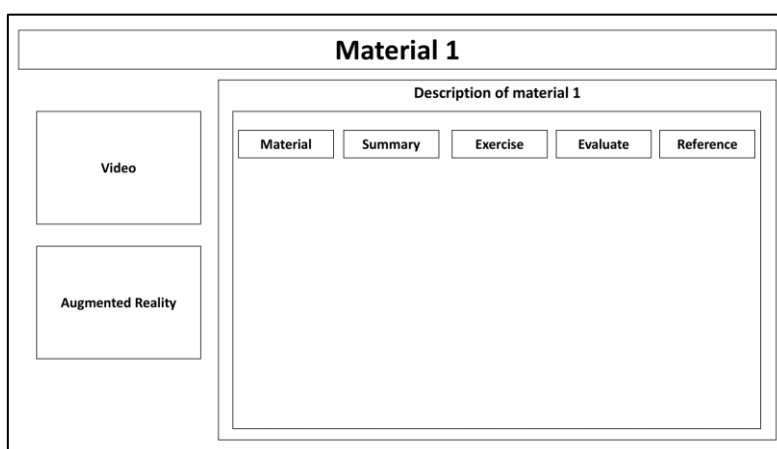

Figure 8
Storyboard of Material Sub Menu

Development Stage of Designing Learning Materials of Indonesian Language Course based on Augmented Reality and Interactive Website

Development was the process of making blueprint to be reality in creating an interactive website. In this stage, the previous design would be translated into functional digital form. This process included various technical and design aspects starting from choosing appropriate platform, building website structures, and integrating provided content. In developing website for Indonesian language course, WordPress was chosen as platform used because its flexibility in managing interactive content.

The first stage in this development was to install and configure WordPress on the server or hosting that had been selected. This process included basic settings such as choosing responsive themes to support accessibility and adjusting initial setting with learning needs. The theme had to support the integration of additional plugin for features of Augmented Reality, interactive video, and easy navigation for students.

When installation and basic configuration had been finished, the next step was to develop the structure and layout of the website. The structure referred to blueprint and included the placement of menu, sub-menu, material page, and other interactive elements. In this stage, it was very important to ensure that the navigation of the website was designed intuitively, so the students could easily access various learning contents such as material, exercise, evaluation, and summary.

The next step was to integrate the learning content with interactive elements of videos, AR simulations, and quiz. WordPress Plugin which supported Augmented Reality and multimedia elements had to be installed and configured based on learning needs. The contents had to be interesting and adjusted to be easily accessed by all students including disabled students. The display of Augmented Reality could be viewed in Figure 9.

Figure 9
Picture Containing Augmented Reality

Augmented Reality was developed using Unity platform. Its result could be in the form of application which could be installed in android smartphones. When the application had been installed, it could be used to scan the figure. This application could be accessed in https://bit.ly/PemindaiAR with an icon as viewed in Figure 10.

Figure 10
Application Icon of Augmented Reality Scanner

The final stage in development was trials and evaluation. When all elements were integrated, website had to be tested to ensure that all features run well. The trials included the materials and website. The eligibility test of material aimed to ensure that the content presented in website were appropriate with the learning objectives to support students' understanding effectively. In this stage, the materials which had been integrated on the website would be tested to know its relevance, accuracy, and suitability with the curriculum of Indonesian language course. This assessment was carried out by involving lecturers of Indonesian language to provide constructive feedback. The trial included verification that the information was accurate, up-to-date, and relevant to university students. Eligible test of material was measured by validator. Its result obtained the criteria "Eligible with good predicate".

When the material was stated to be eligible, the next step was to conduct an eligibility test of media. It involved interactive media evaluation in websites, such as video, AR simulation, and other multimedia elements. This eligibility test was conducted to assess the media quality, affordability, and the ease of use. It included examining technical aspects, such as video resolution, AR connectivity to content, and the responsiveness of interactive elements. This assessment was conducted by involving lecturers of learning media, information engineering, or multimedia to provide constructive feedback. In this stage, media compatibility with various devices and browsers was important to be tested. The eligibility test of media was utilized to ensure that all elements had proper function in desktop and mobile devices. It included testing on different browsers to ensure that the media was consistent and did not have technical problems. Result of eligibility test of media obtained the criteria "Eligible with good predicate".

Results of the trials had to be documented in detail, including findings of material and media tests as well as suggestions for improvement. The documentation became a basis to revision and ensure that all website elements fulfilled the learning needs.

After the material and media were eligible and had been improved, the next step was to summarize the evaluation result to create final report. This report included findings of material and media eligibility tests and recommendations for further improvement. Therefore, the interactive website was ready to be used in learning Indonesian language course in which all elements were appropriate and used to support learning objectives. The appearance of the website in development stage could be viewed in Figure 11.

Figure 11
The Appearance of Website in Learning Materials of Indonesian Language

Implementation Stage of Designing Learning Materials of Indonesian Language Course based on Augmented Reality and Interactive Website

The implementation stage in developing learning materials of Indonesian language course based on Augmented Reality and interactive website was a crucial phase in which all developed elements were implemented in universities that have disabled students. It was conducted hybrid with several meetings. The first meeting was the introduction of learning materials of Indonesian language course based on Augmented Reality and interactive website that could be accessed in https://bahanajarbahasaindonesia.net/. The last meeting was conducted by providing post-test for students.

The implementation stage involved limited and extensive trial tests. The limited trial test involved a small number of students as participants to evaluate eligibility and obtain initial feedback. It was conducted in several meetings to assess the effectiveness of learning material, especially in terms of students' engagement, ease of access, and integration between Augmented Reality and interactive content in website. The data obtained from the limited trial test was used to improve the learning materials before being implemented on a wider scale. In this stage, students provided suggestions to add PowerPoint file in website and menu to communicate with developer.

After conducting improvements based on the result of thelimited trial test, the next step was extensive trial test. In this step, learning material was implemented to more students in different classes. Extensive trial test aimed to investigate how learning material function in various contexts and to assess the stability and consistency of the use of AR technology on various students' devices. Moreover, this trial test was used to measure the interactive content in website to support the understanding of disabled students about Indonesian language concept.

The data obtained in extensive trial test was analyzed to evaluate learning quality in form of teaching effectiveness, ease of access, and students' motivation improvement. The main focus of evaluation was the use of AR and interactive elements in website which supported students in understanding the concept of Indonesian language and improving their autonomous learning. In this step, students provided suggestions to add menu that could read text to produce voice sound. It enabled blind students to understand the material by listening to the sound.

The result of extensive trial test became a basis for making final decision on the implementation of this learning material in all relevant classes. When the evaluation showed positive results, the learning materials based on AR and interactive website would be implemented in the curriculum. Furthermore, additional training courses for lecturers should be considered to ensure the

success of technology implementation in the teaching and learning process. The last step of implementation stage also included the development of user guide and continuous improvement based on users' suggestions.

Evaluation Stage in Designing Learning Material of Indonesian Language Course based on Augmented Reality and Interactive Website

In the evaluation stage, there were two main activities. The first activity was to provide test for students. The test consisted of 10 questions in the form of multiple choices. The test was conducted before and after learning process using learning materials based on AR and interactive websites. This test was used to measure students' understanding. Results of pre-test and post-test were used to test hypothesis. After testing the hypothesis, the results of pre-test and post-test were analyzed using a mean similarity test of T-test. The analysis result of students' achievement scores using the T-test could be viewed in Table 4.

Table 4
Analysis Result of Students' Achievement Scores using T-test

	Pre-test	Post-test
Mean	63	86
Standard deviation	7,55928946	5,345224838
variance	57,14285714	28,57142857
sp	6,546536707	
t_{count}	16,60398469	
t_{table}	2,17881283	

After conducting analysis, the data of table 4 was obtained. It could be viewed that the value of t_{count} was higher than t_{table}, The value of t_{count} = 16,604 and the value of t_{table} = 2,1788. The hypothesis H_o stated that learning materials of Indonesian language course based on Augmented Reality and interactive website did not provide positive influence on students' learning outcomes. The hypothesis H_1 stated that learning materials of Indonesian language course based on Augmented Reality and interactive website provided positive influence on students' learning outcomes. In this case, H_o was rejected and H_1 was accepted.

The second activity of this stage was to revise product based on students' suggestions. The first improvement was made to add PowerPoint file in the website. It aimed to provide easy access for students about the presented material in familiar format. The PowerPoint was created systematically and designed to be compatible with the needs of students, including disabled students. PowerPoint could be downloaded and studied offline, so it enabled students to repeat and understand important concepts. It was placed under AR menu in each learning outcome. The display of PowerPoint could be viewed in Figure 12.

Figure 12
The Display of PowerPoint in Website

The second improvement was to add WhatsApp icon. This icon had function to have direct communication with developer when disabled students obtained obstacles. When they face technical problems in accessing materials, they could contact developers through WhatsApp by clicking the icon. This feature was designed to provide quick response and solution, so students' learning process was not disrupted. Direct communication could minimize obstacles in using website. The WhatsApp icon was more inclusive for all users, including students with disabilities. This icon was placed in the lower right corner of website which appeared in each menu. This icon could be viewed in Figure 13.
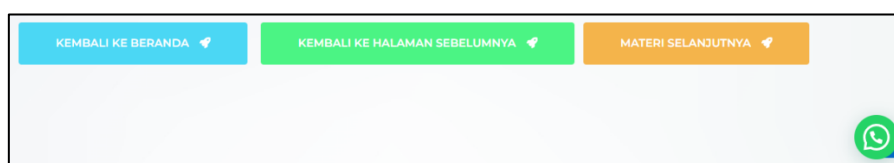
Figure 13
The Appearance of WhatsApp Icon

The third improvement was to add the menu of audio material. This menu was used to read text in each learning outcome. It was placed after PowerPoint menu. The display of audio material menu could be viewed in Figure 14.
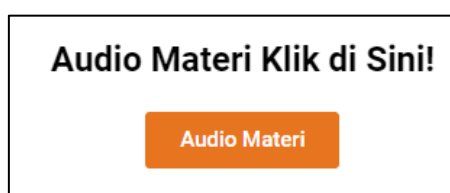

Figure 14
The Display of Audio Material Menu

When this menu was clicked, it would direct to a new window containing text and system of text-to-speech. This menu was utilized to facilitate students in reading text in each learning outcome. It was designed to help students who had difficulties in reading or were blind to be able to access information easily. This feature became part of commitment in creating an inclusive learning environment which enabled students to access materials based on their preferences. The display of text-to-speech menu could be viewed in Figure 15.
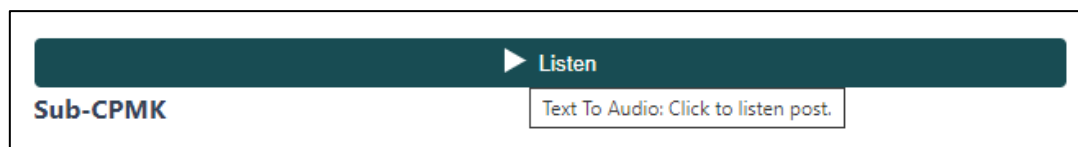
Figure 15
The Display of Text-to-Speech Menu

The use of website had been often used in education field to facilitate learning process, including learning Indonesian language. Santoso et al., (2016) stated that website was utilized to increase students' learning achievement optimally. It was conducted by make interactive website to be learning materials of Indonesian language course. Results of interactive website in Indonesian language learning process were quite satisfactory because the percentage score was 91,58% in the success of field test. However, this study only explained the assessment result of interactive website without providing further description about this learning material. Moreover, this learning material was not intended for students with disabilities.

Nurhabibah et al., (2021) stated that website could be used to design learning material which was able to evaluate materials of Indonesian language. The website was Educandy Website that could be accessed on www.educandy.com. This research focused on how to use Educandy to create learning evaluation of Indonesian language to be interesting for students. However, its results only focused on the assessment of media and material expert without measuring the effectiveness of website for students' learning process, especially students with disabilities.

Not only the website, Augmented Reality (AR) was also included in supporting tool to design learning materials that mostly discussed by researchers. Hapsari & Wulandari (2021) highlighted AR to support Indonesian language learning. Using AR, the books of procedure text could be packaged more interesting. The result of this research focused on the assessment of material expert, media expert, and students. Those assessment results provided satisfactory responses because the percentage of final score was high. However, this research had not explained how AR used in textbooks.

Another research about AR was conducted by Somadayo et al., (2024). AR was used to create learning materials of Indonesian language. It made learning activities to be more interactive, motivated, fun, and provided more opportunities to increase creativity. Learning materials which were packaged using AR, namely text varieties, text-forming language, fictional texts, non-fictional texts, literary appreciation and creation. Results of this study explained how the materials were packaged using AR and how AR implemented in learning process. However, the results of the research did not explain students' (especially blind students) responses on learning materials.

Therefore, this study was aimed to perfect the explanation of the process in designing interactive website using AR and to investigate students' responses on learning materials in Indonesian language course. The integration was a novelty of this study because websites and AR were often presented separately and rarely used together in the learning process. By combining both of them, the researchers could design learning materials of Indonesian language course for students with disabilities in which had not been conducted in previous studies.

Based on the description in previous discussion, there was a novelty. The novelty of this study was showed by the existence of learning materials in Indonesian language course based on Augmented Reality and interactive website. This learning material could be used by students with disabilities especially the blind students.

CONCLUSION

Conclusion of this study was that learning materials of Indonesian language course could be developed by implementing ADDIE model, so it could be utilized by students with disabilities. The development of learning materials of Indonesian language course based on AR and interactive website produced learning media, which was inclusive, adaptive, and interactive. This learning material not only facilitated access for disabled students, it also improved their engagement and understanding of

material through more immersive and structured learning experiences. The use of AR provided more attractive and easy-to-understand visualization, while the interactive website was designed with suitable features for disabled students, such as automatic text-to-speech, simple navigation, and display customization.

The implication of this study was to provide important contribution to improve the quality of inclusive education in university level. By integrating Augmented Reality technology and interactive design of website, the teaching and learning process could be adjusted to the needs of blind students, support autonomous learning, and ensure that all students obtained the learning objectives. Future researchers were recommended to apply it to make learning materials for other disabled students. Moreover, this study provided opportunities for other educational institutions to adopt similar technology in order to create more adaptive and friendly learning environment for students with disabilities in various courses. It showed that innovation in developing learning materials based on technology could be a solution in facing challenges in higher education.

DECLARATIONS

REFERENCE

Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational research review, 20*, 1-11. https://doi.org/10.1016/j.edurev.2016.11.002

Alenezi, A. (2020). The role of e-learning materials in enhancing teaching and learning behaviors. *International Journal of Information and Education Technology, 10*(1), 48-56. http://dx.doi.org/10.18178/ijiet.2020.10.1.1338

Ali, A. J. A. K. N., & Siddiq, M. (2022). Students' perception towards the time suitability for Indonesian language course. *ETUDE: Journal of Educational Research, 3*(1), 9-13. https://doi.org/10.56724/etude.v3i1.168

Altman, B. M. (2014). Definitions, concepts, and measures of disability. *Annals of epidemiology, 24*(1), 2-7. https://doi.org/10.1016/j.annepidem.2013.05.018

Alzahrani, N. M. (2020). Augmented reality: A systematic review of its benefits and challenges in e-learning contexts. *Applied Sciences, 10*(16), 5660. https://doi.org/10.3390/app10165660

Aydin, A., & Aytekin, C. (2018). Teaching materials development and meeting the needs of the subject: a sample application. *International Education Studies, 11*(8), 27-38. http://dx.doi.org/10.5539/ies.v11n8p27

Cahyana, U., Paristiowati, M., Marliana, N. L., Ansoriyah, S., Nabilah, R., Pasha, R. D., … & Mege, R. A. (2020). Development of mobile learning for general courses Indonesian language education as an effort to improve the quality of lectures at education universities in Indonesian. *Universal Journal of Educational Research, 8*(10), 4684-4691. https://doi.org/10.13189/ujer.2020.081037

Cai, S., Liu, C., Wang, T., Liu, E., & Liang, J. C. (2021). Effects of learning physics using augmented reality on students' self-efficacy and conceptions of learning. *British Journal of Educational Technology, 52*(1), 235-251. https://doi.org/10.1111/bjet.13020

Chao, W. H., & Chang, R. C. (2018). Using augmented reality to enhance and engage students in learning mathematics. *Advances in Social Sciences Research Journal, 5*(12), 455-464. https://doi.org/10.14738/assrj.512.5900

Darmuki, A., Nugrahani, F., Fathurohman, I., Kanzunnudin, M., & Hidayati, N. A. (2023). The impact of inquiry collaboration project-based learning model of Indonesian language course achievement. *International Journal of Instruction, 16*(2), 247-266. http://dx.doi.org/10.29333/iji.2023.16215a

Eriyanti, R. W. (2017). Pengembangan bahan ajar keterampilan berbicara interaktif bagi mahasiswa. *KEMBARA: Jurnal Keilmuan Bahasa, Sastra, dan Pengajarannya, 3*(1), 98-106. https://doi.org/10.22219/kembara.v3i1.4381

Fatmawati, F., Hardiyanti, H., & Muktamar, A. (2023). Implementation of differentiated learning in indonesian language courses: realizing freedom of learning. *ETDC: Indonesian Journal of Research and Educational Review, 2(*4), 44-54. https://doi.org/10.51574/ijrer.v2i4.935

Ferdiansyah, F., & Irfan, D. (2021). Interactive learning media based on website in vocational school. *Al-Ishlah: Jurnal Pendidikan, 13*(1), 755-762. https://doi.org/10.35445/alishlah.v13i1.591

Garton, S., & Graves, K. (2014). Identifying a research agenda for language teaching materials. *The Modern Language Journal, 98*(2), 654-657. https://www.jstor.org/stable/43649908

Halimatusyadiah, H., & Disman, D. (2023). The benefits of interactive media websites through google sites on learning outcomes of elementary school students. *Jurnal Lingua Idea, 14*(1), 92-108. https://doi.org/10.20884/1.jli.2023.14.1.8305

Hamzah, M. L., Rizal, F., & Simatupang, W. (2021). Development of augmented reality application for learning computer network device. *International Journal of Interactive Mobile Technologies, 15*(12). https://doi.org/10.3991/ijim.v15i12.21993

Hapsari, T. P. R. N., & Wulandari, A. (2020). Analisis kelayakan buku ajar milenial berbasis augmented reality (AR) sebagai media pembelajaran teks prosedur di Magelang. *Diglosia: Jurnal Kajian Bahasa, Sastra, dan Pengajarannya, 3*(4), 351-364. https://doi.org/10.30872/diglosia.v3i4.125

Hasanudin, C., Fitrianingsih, A., Utomo, D. N. P., & Fitriyana, N. (2022). Android based material to teach early reading for primary students using construct 2 apps. *Ingenierie des Systemes d'Information, 27*(6), 933. https://doi.org/10.18280/isi.270609

Herawati, A. F., Siregar, A., Yusrizal, Y., Rahma, A. A., Sari, A. L., & Irwandi, I. (2021). Utilization of e-learning as media in indonesian language courses in higher education post covid-19 pandemic. *AL-ISHLAH: Jurnal Pendidikan, 13*(3), 2757-2766. https://doi.org/10.35445/alishlah.v13i3.1455

Jdaitawi, M. T., & Kan'an, A. F. (2022). A decade of research on the effectiveness of augmented reality on students with special disability in higher education. *Contemporary Educational Technology, 14*(1). https://doi.org/10.30935/cedtech/11369

Jensen, M. P., Smith, A. E., Bombardier, C. H., Yorkston, K. M., Miró, J., & Molton, I. R. (2014). Social support, depression, and physical disability: age and diagnostic group effects. *Disability and health journal, 7*(2), 164-172. https://doi.org/10.1016/j.dhjo.2013.11.001

Kendall, L. (2016). Higher education and disability: exploring student experiences. *Cogent Education, 3*(1), 1256142. https://doi.org/10.1080/2331186X.2016.1256142

Kondo, T., Takahashi, T., & Shirasawa, M. (2015). Recent progress and future challenges in disability student services in Japan. *Journal of Postsecondary Education and Disability, 28*(4), 421-431.

Maharany, E. R., Rahmati, N. A., & Basori, B. (2022). Students' perceptions towards the Indonesian language course. *JEELL (Journal of English Education, Linguistics and Literature) English Departement of STKIP PGRI Jombang, 8*(2), 128-138. https://doi.org/10.32682/jeell.v8i2.2210

Maki, K. E., Burns, M. K., & Sullivan, A. (2017). Learning disability identification consistency: The impact of methodology and student evaluation data. *School Psychology Quarterly, 32*(2), 254. https://psycnet.apa.org/doi/10.1037/spq0000165

Mardianti, F., Purnama, D., Zaenab, S., & Rusdiana, D. (2023). Developing website-based interactive learning media integrated with kirchhoff's law experimental tools. *Jurnal Eksakta Pendidikan (JEP), 7(*1), 39-50. https://doi.org/10.24036/jep/vol7-iss1/755

Mayembe, E., & Nsabata, S. (2020). Print-based learning media. *Journal Educational Verkenning, 1*(1), 1-7. https://doi.org/10.48173/jev.v1i1.23

Miles, M. B., & Huberman, A. M. (2007). *Analisis Data Kualitatif: Buku Sumber tentang Metode-Metode Baru.* terjemahan tjetjep rohendi rohidi. Jakarta: Universitas Indonesia Press.

Nieto-Márquez, N. L., Baldominos, A., & Pérez-Nieto, M. Á. (2020). Digital teaching materials and their relationship with the metacognitive skills of students in primary education. *Education Sciences, 10*(4), 113. https://doi.org/10.3390/educsci10040113

Nugroho, A., Lazuardi, D. R., & Murti, S. (2019). Pengembangan bahan ajar LKS menulis pantun berbasis kearifan lokal siswa kelas vii SMP Xaverius Tugumulyo. *KEMBARA: Jurnal Keilmuan Bahasa, Sastra, dan Pengajarannya, 5*(1), 1-12. https://doi.org/10.22219/kembara.v5i1.8352

Nurhabibah, P., Fikriyah, F., & Dewi, K. (2021). Pengembangan website educandy sebagai alat evaluasi pada pembelajaran bahasa Indonesia untuk siswa kelas V. *Fon: Jurnal Pendidikan Bahasa dan Sastra Indonesia, 17*(2), 255-264. https://doi.org/10.25134/fon.v17i2.4652

O'Shea, A., & Meyer, R. H. (2016). A qualitative investigation of the motivation of college students with nonvisible disabilities to utilize disability services. *Journal of Postsecondary Education and Disability, 29*(1), 5-23.

Pahamzah, J., Syafrizal, S., & Amalia, R. (2022). Interactive website for teaching english as a foreign language. *Journal of Positive School Psychology*, *6*(6), 9310-9316.

Puspitoningrum, E. (2015). Pengembangan bahan ajar menulis kembali dongeng untuk siswa SMP kelas VII. *KEMBARA: Jurnal Keilmuan Bahasa, Sastra, dan Pengajarannya, 1*(2), 152-162. https://doi.org/10.22219/kembara.v1i2.2612

Puspitoningrum, E., & Rahmayantis, M. D. (2018). Bahan ajar Pacelathon Undha Usuk Basa Jawa Lokalitas Kediri sebagai penguatan karakter tata krama berbicara siswa dalam mata pelajaran muatan lokal bahasa daerah. *KEMBARA: Jurnal Keilmuan Bahasa, Sastra, dan Pengajarannya, 4*(1), 21-34. https://doi.org/10.22219/kembara.v4i1.5687

Rahman, T., Yufiarti, Y., & Nurani, Y. (2024). Enhancing early childhood literacy through game-based interactive digital media development. *International Journal of Religion, 5*(11), 2598-2608. https://doi.org/10.61707/7cprvh13

Rahmayantis, M. D., & Lailiyah, N. (2021). Pengembangan materi bahan ajar menulis puisi dengan menggunakan teknik pemodelan di SMPN 1 Tulungagung. *KEMBARA: Jurnal Keilmuan Bahasa, Sastra, dan Pengajarannya, 6*(2), 243-254. https://doi.org/10.22219/kembara.v6i2.14025

Rahmi, U., & Azrul, A. (2021). Message design of printed and digital material to meaningful learning. *Al-Ta Lim Journal, 28*(1), 26-34. http://dx.doi.org/10.15548/jt.v28i1.634

Riddell, S., & Weedon, E. (2014). Disabled students in higher education: discourses of disability and the negotiation of identity. *International Journal of Educational Research, 63*, 38-46. https://doi.org/10.1016/j.ijer.2013.02.008

Rodríguez, F. C., Frattini, G., Krapp, L. F., Martinez-Hung, H., Moreno, D. M., Roldán, M., Salomón, J., Stemkoski, L., Traeger, S., Peraro, M. D., & Abriata, L. A. (2021). MoleculARweb: a web site for chemistry and structural biology education through interactive augmented reality out of the box in commodity devices. *Journal of Chemical Education, 98*(7), 2243-2255. https://doi.org/10.1021/acs.jchemed.1c00179

Salvador-Ullauri, L., Acosta-Vargas, P., & Luján-Mora, S. (2020). Web-based serious games and accessibility: a systematic literature review. *Applied Sciences, 10*(21), 7859. https://doi.org/10.3390/app10217859

Santoso, A. D., Pudjawan, K., & Suwatra, I. I. W. (2016). Pengembangan website pembelajaran interaktif untuk mendukung blended learning pada mata pelajaran bahasa Indonesia di SMP negeri 3 Banjar. *Jurnal Edutech Undiksha, 4*(2). https://doi.org/10.23887/jeu.v4i2.7730

Sanulita, H., Judijanto, L., Prananda, G. P., Fauzi, M. S., & HD, M. I. (2024). Language attitudes and Indonesian language learning in higher education: A relevant study. *Consilium: Education and Counseling Journal, 4*(1), 161-168. https://doi.org/10.36841/consilium.v4i1.4235

Siahaan, P. R. A., & Saragih, E. (2021). Student actions in the learning process of Indonesian language subjects and their implications for improving discussion ability. *Budapest International Research and Critics Institute (BIRCI-Journal): Humanities and Social Sciences, 4*(1), 1440-1448. http://dx.doi.org/10.33258/birci.v4i1.1772

Sitepu, T. (2019). Cooperative Model in language reasoning: Indonesian language teaching materials in teacher training and education faculty of muhammadiyah Sumatera Utara University. *Britain International of Linguistics Arts and Education (BIoLAE) Journal, 1*(2), 51-59. https://doi.org/10.33258/biolae.v1i2.62

Skoufaki, S., & Petrić, B. (2021). Academic vocabulary in an EAP course: Opportunities for incidental learning from printed teaching materials developed in-house. *English for Specific Purposes, 63*, 71-85. https://doi.org/10.1016/j.esp.2021.03.002

Somadayo, S., Jamil, M., & Karim, K. H. (2024). Pengembangan media pembelajaran Bahasa Indonesia berbasis teknologi augmented reality. *Journal of Education Research, 5*(1), 562-569. https://doi.org/10.37985/jer.v5i1.733

Syahrizal, S., Yasmi, F., & Mary, T. (2024). AI-enhanced teaching materials for education: a shift towards digitalization. *International Journal of Religion, 5*(1), 203-217. https://doi.org/10.61707/j6sa1w36

Thees, M., Kapp, S., Strzys, M. P., Beil, F., Lukowicz, P., & Kuhn, J. (2020). Effects of augmented reality on learning and cognitive load in university physics laboratory courses. *Computers in Human Behavior, 108*, 106316. https://doi.org/10.1016/j.chb.2020.106316

Tuli, N., & Mantri, A. (2021). Evaluating usability of mobile-based augmented reality learning environments for early childhood. *International Journal of Human–Computer Interaction, 37*(9), 815-827. https://doi.org/10.1080/10447318.2020.1843888

Vlachou, A., & Papananou, I. (2015). Disabled students' narratives about their schooling experiences. *Disability & Society, 30*(1), 73-86. https://doi.org/10.1080/09687599.2014.982787

Wahyuni, E., Jumiyah, R., & Asry, W. (2024). Use of online websites as interactive learning media in moral creed lessons. *International Journal of Educational Narratives, 2*(3), 322-333. https://doi.org/10.55849/ijen.v2i3.1076

Witham, B., & Brewer, G. (2023). "Giving the People Who Use the Service a Voice": Student Experiences of University Disability Services. *Disabilities, 4*(1), 1-10. https://doi.org/10.3390/disabilities4010001

Zulaeha, I., Hasanudin, C., & Pristiwati, R. (2023). Developing teaching materials of academic writing using mobile learning. *Ingénierie des Systèmes d'Information, 28*(2), 409. https://doi.org/10.18280/isi.280216