

## **Development of Audiovisual Learning Media Based on Augmented Reality for Dyslexia Students (Lexiary- Dyslexia Augmented Reality)**

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Received : November 2022

Accepted : December 2022

Published : December 2022

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### **Abstract**

In every learning process, it is necessary to uphold equality and justice, so the government and all of us must continue to provide good educational services for all characteristics of students without exception. In most universities in Indonesia, the quality of services and the quality support for students with special needs are still not met properly. To achieve the goals of higher education, universities certainly must provide quality services and quality support services not only for normal students but also for Students with Special Needs (SSNs). The occurrence of the Covid-19 pandemic requires good learning planning so that learning objectives can still be achieved. A learning process that is effective, efficient, friendly, and by the conditions of Covid-19, will have a positive impact, especially on SSNs. Therefore, lecturers must make good learning plans so all students can learn according to their respective characteristics. This study aims to develop Augmented Reality (AR)-based learning media for students with special needs dyslexia during online learning so that the dyslexic SSN understands lecture material that is carried out fully online. The research and development method uses the Borg and Gall model, combined with the Multimedia Development Life Cycle (Luther) model in developing AR learning media. The results showed that AR learning media was feasible after going through several stages of product development, testing and revision. At the implementation stage, this AR media also improves the learning outcomes of SSN Dyslexia.

Keywords: Augmented reality, Student with Special Needs, Dyslexia

### **Introduction**

The current conditions in almost all of the world do not have the potential for a pandemic in Indonesia caused by the coronavirus or commonly referred to as Covid-19. This condition forces everyone to make various prevention efforts and break the chain of the spread. Among them are the obligation to use masks, wash hands as often as possible, maintain distance and reduce the number of people involved. This pandemic period has changed the pattern of routines in almost all sectors, economic, social, political, and many more without education. The face of world of education is undergoing very significant and rapid changes (Cho, 2021; Nagaraju, 2020). Every educational institution, whether kindergarten, elementary, secondary, to higher education is required to carry out learning with an online process abbreviated as online. The implementation of the learning process, the presence of both students and teachers in the classroom, will pose a high or dangerous

risk. So that each learning process needs to be designed with the characteristics of diverse students so that all students can get the right education (González, 2022; Nagaraju, 2020).

Every process needs respect and justice, so the government and all of us have to provide good educational services for all students without risk (Nasir, 2021; Staric, 2013). Various policies have been regulated in such a way both at the level of education units to tertiary institutions. As for students with disabilities in Higher Education, Referring to Law Number 8 of 2016 Article 10 and Law Number 12 of 2012 article 32, which states that the form of providing services to persons with disabilities in Higher Education must pay attention to 1) quality services, both the provision of educators and program activities by the needs and characteristics of persons with disabilities; 2) supporting quality, such as learning methods, learning media, and physical facilities that are by the characteristics of persons with disabilities without reducing the quality of learning to be achieved. However, in most universities in Indonesia, the quality of support for students with special needs is still well-catered. To achieve the goals of higher education, of course, universities must provide quality services and supporting services not only for normal students but also for Students with Special Needs (SSNs) (Li, 2021; Nasir, 2021). An effective learning process, friendly and by all student needs, will certainly have a positive impact on self-confidence and motivation to learn SSNs.

This pandemic period is not an easy time for students, especially for SSNs. Therefore, universities are expected to be able to design and develop innovative and appropriate learning models for SSNs according to their specificity. In addition, there needs to be involvement and participation of all parties in learning. This participation is not only intended for students but how lecturers are required to develop learning models and innovative learning media. Law number 12 of 2012 article 35 paragraph 2 states that "The Higher Education Curriculum is developed by every university concerning the National Higher Education Standards for each Study Program which includes the development of intellectual intelligence, noble character, and skills" (Policy-Education- Inclusive-in-PT-Finals, N.D.). Universities must be able to provide opportunities for both non-SSN and SSNs to gain direct learning experiences in the community together, students are active in the learning process, and learning must also consider student needs, and provide appropriate services. All university students are entitled to the development of intellectual intelligence, noble character, and skills.

The condition that occurred at the beginning of the pandemic was the online learning process in which there were SSNs and regular students, not using learning processes and media that prioritized justice, effectiveness, and comfort for all students. Some initial findings that form the basis for the need for the development of innovative learning models for SSN include; lecturers do not have a specific test tool for assessing each student's specificity, have not been able to develop learning tools according to the specificity of students, have not used a friendly and student-centered learning approach, lack of attention and special time for SSNs in understanding the lecture material, the assessment process that the same between regular students and SSNs, and the development of learning media for SSNs with a pandemic condition which fully uses online learning. The results of interviews with the student admissions unit obtained data that there are 4 SSN people with dyslexia who take learning media development courses. Based on these initial data, an innovative learning model was developed by combining the development of special learning media for dyslexic students (González, 2022; Queen, 2021). An innovative learning model developed specifically for students suffering from dyslexia is called The Dyslexia Augment Reality Inductive Model (LEXIARY Model). The LEXIARY learning model is a combination of The Picture Word Inductive Model (PWIM) which emphasizes discovery or inquiry with the development of learning media with Augment Reality technology designed for students with special needs dyslexia (Putra, 2022; Risdianto, 2020). Calhoun (1999: 22) developed a Picture Word Inductive Model (PWIM), using pictures containing familiar objects, actions, and scenes to draw words from students' listening and speaking vocabulary (Pratiwi, 2021; Rosyada, 2018). In the LEXIARY learning model, the pictorial words used are replaced with augmented reality media that are adapted to technological advances and the current online learning process (Ismaili, 2017; Perera, 2012; Staric, 2013).

This model is expected to increase students' understanding of the lecture material given by the lecturer through online learning. LEXIARY is designed as a learning model that can provide opportunities for students to have interesting learning experiences that are by their specificity. An interesting learning experience will of course increase students' learning motivation and in the end can improve their learning outcomes (Putri et al.,

2021). Children with dyslexia are sometimes not detected until they child is a teenagers and even into adulthood. Usually, the symptoms are also similar to those that appear in children without dyslexia. The various characteristics of dyslexia in adolescents and adults, namely; Difficulty in reading, especially reading aloud, Slow reading and writing skills, problems with spelling, Always avoiding reading-related activities, Often pronouncing names or words incorrectly, Difficulty understanding certain idioms, such as light-handed, loud heads, etc., Spending a long time to complete tasks that involve reading and writing, Difficulty summarizing a story, Difficulty learning foreign languages, Difficulty memorizing, and Difficulty working on math problems (Hiscock & Leigh, 2020; Lenz et al., 2016; Tafti et al., 2014). In addition, in general, children who experience dyslexia as teenagers will be seen; with depression, especially when studying, withdrawing from the environment, losing interest in school, and having the low motivation to learn. Therefore, it is necessary to design interesting digital learning media through online learning, one of which is augmented reality (AR) based learning media.

The purpose of this study is to develop AR-based learning media that is intended for students with special needs dyslexia during online learning so that the dyslexia SSN understands lecture material that is carried out fully online (Miundy, Zaman, Nordin, et al., 2019; Miundy, Zaman, Nosrdin, et al., 2019). The benefits obtained from this development research are the availability of media specifically designed for dyslexia SSN, providing new insights in developing similar media both on different materials in learning media development courses or other courses, and providing new learning experiences in the online learning process. , motivate and increase interest in learning SSN in online learning, improve students' digital competence in the 21st century, as well as the availability of interesting and interactive digital learning resources. Through an innovative learning model developed, namely The Dyslexia Augment Reality Inductive Model (LEXIARY Model), universities as institutions that provide educational services for every student, including students with special needs as a form of applying the principle of "Education for All".

## **Research Methodology**

The Dyslexia Augment Reality Inductive Model (LEXIARY Model) learning innovation model that was developed is a combination of two development methods, namely for research methods using research and development methods Borg and Gall models (Borg, Joyce P. Gall, 2014; Meredith D. Gall et al. al., 2013; Meredith D. Gall, Joyce P. Gall, 2018), while to develop learning media using the Multimedia Development Life Cycle (Luther) model (Arpiansah et al., 2021; Hilarius Alfian, 2021; Supriatna et al., 2020). The following is a combination of models used in developing this learning innovation.

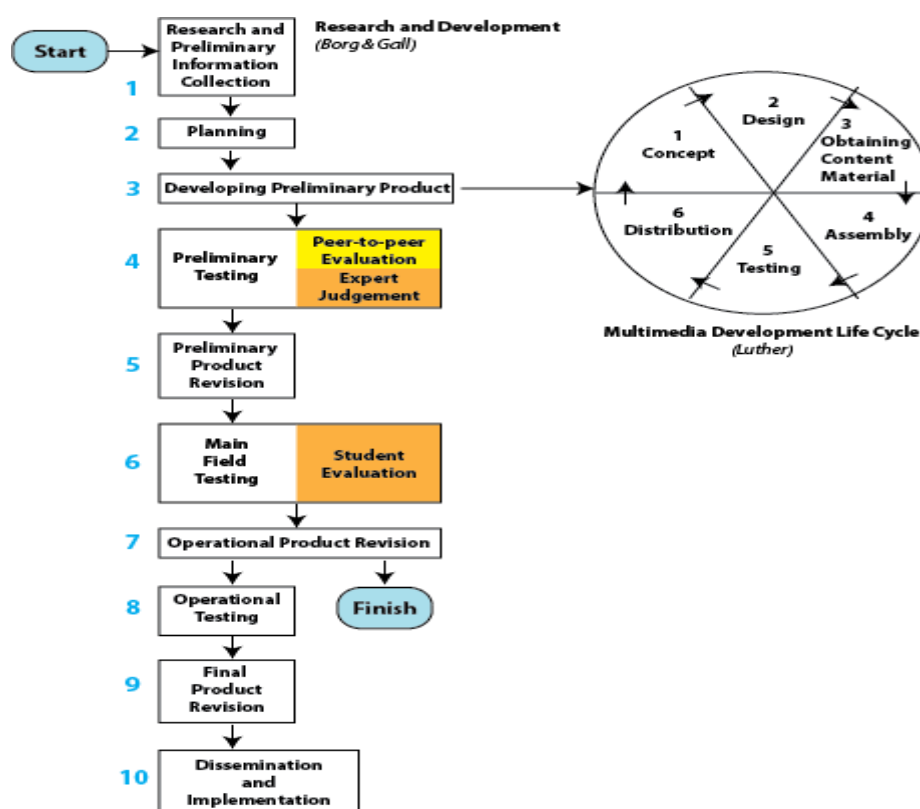


Figure 1. Combined research method between Research and Development (Borg & Gall) and Multimedia Development Life Cycle (Luther). Modified by Hadi Sutopo, Widyasari, Agustian (Agustian et al., 2021; Widyasari et al., 2019).

## Results

Needs analysis (need assessment) is carried out to find out the needs of students. This stage is carried out at the beginning of development with the aim that researchers can develop learning models that suit the needs of all students in the learning media development course. A needs analysis was carried out by distributing questionnaires and interviews to 28 students who had carried out learning and were in the learning media development class. The selection of students who take the learning media development course because they have 4 SSNs with dyslexia specificity. In addition to students, interviews were conducted with a lecturer who support inclusive education courses and a lecturer who teach learning media development courses as team teaching. Furthermore, the lecturer was made a media expert and content expert at the pilot stage. Lecturers will also be used as informants to assess the feasibility of the learning model developed. This needs analysis is adapted to the learning model developed, namely The Dyslexia Augment Reality Inductive Model (Lexiary), here are the stages of research and development using the Borg and Gall model.

First. *Research and Preliminary Information Collecting.* In this stage, identification and analysis of the needs for the development of learning innovations are carried out, the needs of users, namely students with special needs with the specificity of dyslexia and teaching lecturers, literacy needs, and the ability to use media, as well as infrastructure and applications that support the development process. This research was conducted under different conditions and the learning process was not carried out in the usual way. This is because the Covid-19 pandemic requires all learning and evaluation processes to be carried out online, including the identification of students with special needs with dyslexia which is also carried out online from the new student admissions unit. At this stage, several analyzes are carried out as follows:

- a) The need for the development of learning innovation

Before starting the process of developing a learning innovation, of course, identification of the need for why this development is carried out will be carried out. It is important to know to what extent the

development results can be used to improve the initial conditions. For students with special needs (SSNs) dyslexia, it is necessary to have special treatment by supporting lecturers during the learning process. This special treatment does not mean differentiating SSNs from non SSNs, but strengthening the lecturers from both the learning strategies and the learning media used, in the form of evaluation. However, with the current Covid-19 pandemic condition requiring all learning processes to be conducted online, it is difficult for lecturers to reinforce SSNs.

Especially if the media and learning strategies have not been designed specifically and according to their needs. With the development of this learning innovation, it is hoped that it can bridge the gap in the learning process between SSNs and non-SSN. This innovation developed is not specifically intended for SSN students, but this innovation can be used by all students.

b) User needs, namely students with special needs (dyslexia) and lecturers.

It is necessary to know more about the characteristics of SSNs with dyslexia specificity. Dyslexia is also often not detected until children are teenagers and even adults. There are various characteristics of dyslexia in adolescents and adults, namely; difficulty in reading, especially reading aloud, slow reading and writing skills, having problems with spelling, and always avoiding reading-related activities (Fitzpatrick, 2015). In addition, SSNs often mispronounces names or words, has difficulty understanding certain idioms, such as light-handedness, stubbornness, etc., takes a long time to complete tasks that involve reading and writing, has difficulty summarizing a story, and has difficulty learning a language foreign countries, difficulty memorizing, and difficulty doing math problems, with various unique characteristics of SSNs, learning needs to be designed according to their specificity so that learning outcomes and motivation are further increased even though it is done online (McBride, 2019; Ninuk Riswandari & Nurma Yuwita, 2021).

In general, children who experience dyslexia as teenagers will look depressed, especially when studying, because they feel they are left behind by their friends, withdraw from their environment because of low self-esteem, lose interest in learning and have low learning motivation. The results of this development will not only be SSN but also lecturers in delivering lecture material. The process of delivering material will be more effective because this augmented reality-based media can be used repeatedly to strengthen students' understanding of the material.

c) Literacy needs and ability to use media

The results of the analysis are related to literacy needs, especially digital literacy and the ability of SSN to use media is quite capable. This can be seen from the online learning process carried out by SSNs using smartphones in every course they take. In addition to using smartphones, some of them also use notebooks in the learning process. The digital literacy ability of SSN is not much different from that of non SSNs students, namely there are still many SSNs and non SSNs students who do not have very good digital literacy skills.

d) Infrastructure requirements and supporting applications

For SSN students there are no obstacles in the internet network so they can follow the online learning process well. The significant obstacle is more to the application used by the developer. Various supporting applications in developing augmented reality make the media production process quite time-consuming. In this study, the developer uses a combination of Aurasma and Microsoft PowerPoint applications which are familiar to students and lecturers.

Second. *Planning*. After studying the literature and obtaining the necessary information, the next step is to plan the manufacture of the product. An important aspect of planning is the statement of objectives to be achieved in the product to be developed. The purpose of developing this innovative learning model The Dyslexia Augment Reality Inductive Model (LEXIARY Model) is to increase the effectiveness and quality

of learning in inclusive classes, increase motivation and learning outcomes of SSN, and provide learning services that are by SSN, especially the type of dyslexia.

Augment Reality media that will be developed is the media used in the learning media development course with the material characteristics of learning media. The main topics of this material are; media categories based on design, cone of the learning experience (Edgar Dale), characteristics of learning media and examples (fixative, manipulative, and distributive), and criteria for good learning media.

Third. *Developing Preliminary Products.* After initiation in complete planning, the main step in the research and development stage is to make the initial form of the Lexiary product that is ready to be tested. This early product development stage includes the creation of instruments to get feedback from users. Before the trial is carried out, feedback and suggestions from colleagues are needed according to their respective fields of expertise, namely two inclusive education lecturers as material experts and two educational technology lecturers as media experts.

In the 3rd stage of Initial Product Development, AR media development uses the Multimedia Development Life Cycle which consists of 6 stages, namely, concept, design, collecting content material, assembly, testing, and distribution (Goyal et al., 2021; Mustagfaroh et al., 2021; Supriatna et al., 2020). The following is a description of each stage.

- a) *concept.* This stage is carried out by observing the needs generated from the observation stage, and multimedia content generated from the stage of making material according to the development of learning. The goal to be achieved at this feature stage is to develop learning media for learning media features with augmented reality (AR) specifically developed for SSNs. However, this AR media can also be used by students who do not have special needs, because both are in the same class, namely the inclusive class. There is no difference in treatment or in the learning process in the classroom, except for the learning media which is specially designed by the developer.

The type of learning media that will be developed is based on the results of the analysis of prospective users, namely SSN and lecturers, that 90% of lecturers and students both use the Microsoft PowerPoint application in the learning process. There are only 10% who still use the blackboard, usually in courses that contain calculations such as Mathematics, Statistics, Chemistry, Physics, or Research Methodology. The blackboard is a learning medium that teachers cannot use during the Covid-19 pandemic, while Microsoft PowerPoint learning media is still considered monotonous and less attractive because it is only visual media compared to audio-visual or even very little interactive.

Multimedia objects used in developing AR media are in the form of text, images, audio, and animation. Meanwhile, the infrastructure used is smartphones and notebooks. This AR media can be used on all of these infrastructures, the goal is to provide convenience in accessing the learning process according to the abilities of students and lecturers. The following is a conceptual framework for the development of AR media.

Table 1. Development Concept Framework

Multimedia Object	Description
Title	: Characteristics of Learning Media Media categories by design, The cone of the learning experience (Edgar Dale)
Text	: Characteristics of Learning Media (fixative, manipulative, and distributive) Criteria for good learning media.
Picture	: People, Books, Buildings, Plants, etc
Animation	: Text Animation and pictures
Audio	: Background sound
Video	: Augmented Reality
Interactive	: Button, scan camera

- b) *Design*. In this stage, the visual design of screen displays, content maps, interfaces, scripts, storyboards, and navigation structures is carried out. Multimedia design requires a navigation structure or site map that describes the relationship between some content and helps organize content with messages. Most of the navigation maps in multimedia are divided into four types, namely: (1) linear, the information goes sequentially from one frame to another, or from one view to the next. The user cannot access the desired view or jump to the required view; (2) hierarchical, users can create navigation by branching as a tree structure. This navigation structure is suitable for applications for organizational needs;(3) nonlinear, users can create navigation freely in all views; (4) composite, users can make free navigation and can also have a tree structure (Haqi, 2020; Pramesti & Arifin, 2020). However, sometimes with too complex branching, it can be confusing to return to the previous view. In designing a multimedia application, navigation maps are combined with storyboards, helping to visualize the information architecture. In general, storyboards are made to provide an overview of each display of the multimedia that will be created.
- c) *Collecting content materials*. At this stage, the collection of materials such as images, animations, audio, and video along with the making of graphic images, photos, audio, and others needed for the next stage. The materials needed can be obtained from sources such as libraries, materials that already exist in other parties, or special manufacturers carried out by outside parties. Images and applications used in this study were obtained from several sources, namely: Assemblr – Make 3D, Images & Text, and Show in AR! Assemblr EDU, Augmented Class! Augmented Reality for Education, ImagineAR – Augmented Reality, miMind – Easy Mind Mapping, and Aurasma.
- d) *Assembly*. The assembly stage is the stage where all multimedia objects are created based on the storyboard and navigation structure that comes from the design stage. In this stage, illustrations, audio, and video are made, as well as programming if needed.

The applications used at this stage are Unity and Vuforia, while some of the multimedia objects used are obtained from several applications, including Assemblr – Make 3D, Images & Text, and Show in AR! Aurasma and Microsoft PowerPoint.

- e) *Testing.* In multimedia development, it is necessary to do testing (testing) after production, this aims to ensure all systems are functioning properly. Testing is carried out after completion of the manufacturing stage and all data has been entered. First of all, testing is done on a modular basis to ensure that the results are as desired. Some systems have features that can provide information when an error occurs in the program. A good authoring system requires features such as reporting on variable values at execution time or tracking program flow.

User testing is carried out for several purposes, namely to check whether the developed media can be used on different devices. Another goal is to determine the acceptance of prospective users of the results of the development, namely SSNs, non-SSNs, and supporting lecturers. Then triangulation or data validity is carried out, in this case involving several experts or experts according to the needs of this AR media development, namely content experts and media experts according to the background of each expert.

- f) *Distribution.* After a trial that may take several times, at this stage, the master file is made, and guidelines for using learning models, packaging, documentation, and product distribution are carried out. At this stage, the developed media has been revised based on expert input.

Fourth. *Preliminary Testing.* This stage coincides with the testing stage on the MDLC. After the initial product is completed, an initial trial is carried out, namely the evaluation of experts related to the field of inclusive education (content) and experts in educational technology (media).

Fifth. *Preliminary Product Revision.* After the initial trial has been carried out, the next stage is product improvement on the data obtained from the initial trial. This stage also coincides with the distribution stage in MDLC. Suggestions from experts are used to improve the product, and at the end of this stage, a product is obtained that is ready to be used by potential users.

Sixth. *Main Field Testing.* After the initial product was improved according to the advice of inclusive education and educational technology experts, a field trial was carried out to obtain an evaluation of the product. Questionnaires were made to get feedback from SSNs and lecturers. In-depth interviews were conducted with 4 SSNs and a lecturer and the result is that the augmented reality media developed is feasible to use.

Seventh. *Operational Product Revision.* After conducting field trials, the next stage is to study whether the product is by the predetermined objectives. The data obtained in the trial were analyzed, and the developer made the necessary improvements. Operational Product Improvement produces a learning model that can be used. This augmented reality-based learning media is the media that will be used in the learning media development course using The Picture Word Inductive Model (PWIM) method. The learning process is carried out online, therefore this AR media is uploaded to the learning management system (LMS) so that every student can download and learn it.

Eighth *Operational Testing.* After the product improvement was completed, a trial was conducted on the entire class population, both SSN and non-SSNs to determine the suitability of the media with the stages of The Picture Word Inductive Model (PWIM) and the characteristics of SSNs dyslexia.

After a series of analysis, design, and development to the trial stage from various experts, the next step is to implement the product or its application. At this stage, what must be done is to ensure that the steps or learning strategies are by the learning model for SSNs dyslexia, namely the inductive picture word model. This model was chosen according to the characteristics of SSNs who still have difficulty understanding reading, both orally and in writing. Calhoun (1999: 28) states that the learning sequence of the inductive picture word model modified with augmented reality media for dyslexia SSNs (which was modified by the researcher) has cycles and recycling through the following activities:

- a) Students learn Augmented Reality media
- b) Students identify what they see for the lecturer to label
- c) Students read and review the resulting words
- d) Students use the chart to read their own set of words
- e) Students classify words according to the properties they can identify
- f) Students develop titles, sentences, and paragraphs about their pictures.
- g) The length of the unit and the number of lessons in one unit depending on the variety of images, the age and language development of the student, as well as the learning achievement of the subject.

Ninth. *Final Product Revision.* Product improvement based on the results of operational trials. During the learning process, the lecturer also observed and recorded all the learning processes from the beginning to the end. The results of the observations were submitted to the researcher for revision. At this stage, the lecturer also conducts a material mastery test for all students, and the SSNs learning outcomes become the focus of the assessment and are used as the basis for revising the final product. The results of the observations show that the Lexiary model can run very well and the learning outcomes of SSNs dyslexia have also increased. It appears that SSNs and non SSNs are actively participating in the learning process.

Tenth. *Dissemination and Implementation.* The implementation and dissemination stages of the Lexiary model were carried out on respondents with a wider range. This study was not carried out until the dissemination stage, with the consideration that there was a need for initial observations to identify students with special needs dyslexia and the learning process that took place at the college.

## **Conclusion**

This Lexiary Model needs to be disseminated to other universities that have SSN dyslexia. To obtain AR media that is ready to be used and developed as needed, it is necessary to consider the originality of the application to be used. The applications that will be used in the development of this AR media are the Unity and Vuforia applications. If you look at the development of IT and the number of applications that are obtained for free or not paid, this makes it easier for developers if only their use is only for limited circles such as in classrooms. However, copyright in any form in the digital world is something that needs to be considered in its use. Try not to infringe on copyright even if it's just a simple text or image.

## **References**

- Agustian, M., Sutopo, H., & Widyasari. (2021). DEVELOPING EDUCATIONAL MOBILE GAME ON NUSANTARA HERITAGE THEMATIC LEARNING FOR ELEMENTARY SCHOOL. *Journal of Southwest Jiaotong University*, 56(6), 959–972. <https://doi.org/10.35741/issn.0258-2724.56.6.84>
- Arpiansah, R., Fernando, Y., & Fakhrurozi, J. (2021). Game Edukasi VR Pengenalan Dan Pencegahan Virus Covid-19 Menggunakan Metode MDLC Untuk Anak Usia Dini. *Jurnal Teknologi Dan Sistem Informasi*, 2(2).

- Borg, Joyce P. Gall, walter R. (2014). Applying Educational Research: How to Read, Do, and Use Research to Solve Problems of Practice. In *INew York and london. Longman publishing Inc.*
- Cho, M. J. (2021). The emergence of virtual education during the COVID-19 pandemic: The past, present, and future of the plastic surgery education. *Journal of Plastic, Reconstructive and Aesthetic Surgery*, 74(6), 1413–1421. <https://doi.org/10.1016/j.bjps.2020.12.099>
- Fitzpatrick, V. R. (2015). Cognitive diversity in undergraduate engineering: Dyslexia. *Dissertation Abstracts International Section A: Humanities and Social Sciences*, 76(5-A(E)).
- González, M. S. (2022). Evaluation of online teacher training programs on innovation and digital competences during covid-19: #webinarsunia. *RIED-Revista Iberoamericana de Educacion a Distancia*, 25(1), 121–140. <https://doi.org/10.5944/ried.25.1.30763>
- Goyal, M., Krishnamurthi, R., & Yadav, D. (2021). E-learning methodologies: Fundamentals, technologies and applications. In *E-learning Methodologies: Fundamentals, technologies and applications*. <https://doi.org/10.1049/PBPC040E>
- Haqi, L. (2020). Developing a multimedia presentation for making fragments of passepoille pockets as a learning solution for the 21st century. *Journal of Physics: Conference Series*, 1446(1). <https://doi.org/10.1088/1742-6596/1446/1/012075>
- Hilarius Alfian, F. A. W. I. D. R. (2021). Aplikasi Media Pembelajaran Ipa Kelas V Menggunakan Metode MDLC (Multimedia Development Life Cycle) Studi Kasus SDK Maria Ferrari Maumere. *Increate (Inovasi Dan Kreasi Dalam Teknologi Informasi)*, 7.
- Hiscock, J., & Leigh, J. (2020). Exploring perceptions of and supporting dyslexia in teachers in higher education in STEM. *Innovations in Education and Teaching International*, 57(6). <https://doi.org/10.1080/14703297.2020.1764377>
- Ismaili, J. (2017). Mobile learning as alternative to assistive technology devices for special needs students. *Education and Information Technologies*, 22(3), 883–899. <https://doi.org/10.1007/s10639-015-9462-9>
- Lenz, L., Meisen, T., Pomp, A., & Jeschke, S. (2016). How will the Internet of Things and big data analytics impact the education of learning-disabled students? A Concept Paper. *2016 3rd MEC International Conference on Big Data and Smart City, ICBDS 2016*. <https://doi.org/10.1109/ICBDSC.2016.7460389>
- Li, Q. (2021). A hybrid learning pedagogy for surmounting the challenges of the COVID-19 pandemic in the performing arts education. *Education and Information Technologies*, 26(6), 7635–7655. <https://doi.org/10.1007/s10639-021-10612-1>
- McBride, C. (2019). Coping with Dyslexia, Dysgraphia and ADHD: A global perspective. In *Coping with Dyslexia, Dysgraphia and ADHD: A Global Perspective*. <https://doi.org/10.4324/9781315115566>
- Meredith D. Gall, Gall, J. P., & Borg, W. R. (2013). Educational Research An Introduction Eighth Edition. In *Journal of Chemical Information and Modeling* (Vol. 53, Issue 9).
- Meredith D. Gall, Joyce P. Gall, W. R. B. (2018). Educational Research. In *Language Learners as Ethnographers* (Vol. 6, Issue 3).
- Miundy, K., Zaman, H. B., Nordin, A., & Ng, K. H. (2019). Screening test on dyscalculia learners to develop a suitable augmented reality (AR) assistive learning application. *Malaysian Journal of Computer Science*, 2019(SpecialIssue1). <https://doi.org/10.22452/mjcs.sp2019no1.7>
- Miundy, K., Zaman, H. B., Nordin, A., & Ng, K. H. (2019). Evaluation of visual based augmented reality (AR) learning application (v-ara-dculia) for dyscalculia learners. *International Journal on Informatics Visualization*, 3(4). <https://doi.org/10.30630/joiv.3.4.321>

- Mustagfaroh, K. S., Putra, F. N., & Ajeng, R. S. (2021). Pengembangan Media Pembelajaran Interaktif dengan MDLC Untuk Materi Benda dan Perubahan Sifatnya. *JACIS : Journal Automation Computer Information System*, 1(2).
- Nagaraju, K. C. (2020). Research on efficacy of webinars organized for faculty during lockdown of covid-19. *CEUR Workshop Proceedings*, 2879, 287–303.
- Nasir, S. (2021). Impact of COVID-19 on the Learning Processes of Typically Developing and Special Needs Students in Pakistan. *Asian Journal of University Education*, 17(3), 67–75. <https://doi.org/10.24191/ajue.v17i3.14526>
- Ninuk Riswandari, & Nurma Yuwita. (2021). PERAN MEDIA KOMUNIKASI PEMBELAJARAN BAGI ANAK PENYANDANG DISLEKSIA. *JURNAL HERITAGE*, 9(2). <https://doi.org/10.35891/heritage.v9i2.2782>
- Perera, N. T. (2012). ICT based education for students with special educational needs in Sri Lanka. *International Conference on Advances in ICT for Emerging Regions, ICTer 2012 - Conference Proceedings*, 156–164. <https://doi.org/10.1109/ICTer.2012.6423026>
- Pramesti, D. Y., & Arifin, R. W. (2020). Metode Multimedia Development Life Cycle Pada Media Pembelajaran Pengenalan Perangkat Komputer Bagi Siswa Sekolah Dasar. *Journal of Students' Research in Computer Science*, 1(2). <https://doi.org/10.31599/jsrscs.v1i2.400>
- Pratiwi, C. P. (2021). Picture Word Inductive Model (PWIM) Berbasis E-Learning dalam Pembelajaran Menulis Puisi Siswa Sekolah Dasar di Masa Pandemi Covid 19. *An-Nuha : Jurnal Kajian Islam, Pendidikan, Budaya Dan Sosial*, 8(2). <https://doi.org/10.36835/annuha.v8i2.453>
- Putra, A. B. N. R. (2022). Hi World: The Virtual Book Learning Integrated Augmented Reality to Increase Knowledge of Covid-19 Prevention in The Learning Process Post-Pandemic Era. *International Journal of Interactive Mobile Technologies*, 16(6), 176–187. <https://doi.org/10.3991/ijim.v16i06.29001>
- Putri, L. T., Yanti, H., & Ferdiansyah, A. W. (2021). Pembelajaran English Basic Structure Melalui Picture Word Inductive Model Berbasis Online Learning Bagi Komunitas Berkebutuhan Khusus (Tuli). *JEDU: Journal of English Education*, 1(3). <https://doi.org/10.30998/jedu.v1i3.5822>
- Queen, D. (2021). Technological impact of COVID-19. *International Wound Journal*, 18(2), 129–130. <https://doi.org/10.1111/iwj.13578>
- Risdianto, E. (2020). Rasch model analysis on the feasibility test of basic physics II practical guide using augmented reality. *ARPN Journal of Engineering and Applied Sciences*, 15(4), 482–490.
- Rosyada, A. (2018). Improving Students' Critical Thinking to Develop Variety Essays through Picture Word Inductive Model. *UICELL Conference Proceeding*.
- Starcic, A. (2013). E-Learning and M-Learning for students with special learning needs: Competence registration in design of personalised learning environment. *Outlooks and Opportunities in Blended and Distance Learning*, 273–278. <https://doi.org/10.4018/978-1-4666-4205-8.ch019>
- Supriatna, A. D., Tresnawati, D., Fatimah, D. D. S., & Rahayu, R. E. G. (2020). Development of multi-media based learning media for early childhood education using the MDLC method. *International Journal of Scientific and Technology Research*, 9(3).
- Tafti, M. A., Boyle, J. R., & Crawford, C. M. (2014). Meta-Analysis of Visual-Spatial Deficits in Dyslexia. *International Journal of Brain and Cognitive Sciences*, 3(1).
- Widyasari, W., Sutopo, H., & Agustian, M. (2019). QR code-based learning development: Accessing math game for children learning enhancement. *International Journal of Interactive Mobile Technologies*, 13(11). <https://doi.org/10.3991/ijim.v13i11.10976>

*01.-KEBIJAKAN-PENDIDIKAN-INKLUSIF-DI-PT-final.* (n.d.).