# Development of Digital Central Innovation for Robotic VCDLN (DCIRV) in the Artificial Intelligence Era

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## Abstract

Continuous innovation has been built since 2020 with the development of VCDLN which is intended for developers and users of digital sources widely in Indonesia. This innovation was continued in 2024, with the support of AR and VR Technology based on Artificial Intelligence (AI) developed at the UPI Cibiru Campus. With the support of AR and VR experts, this innovation research product is called DCIRV (Digital Central Innovation for Robotics). This Innovation Research was carried out with a Mix-Method approach to meet the needs of prototype design and educational industry products as well as expert and user testing from the Nusantara region. To measure the quality of innovation products, it has been measured by experts from Bordeaux University France, Kitakyushu University, and McGill University. The findings of the prototype and the DCIRV research findings model, it show that starting from the needs analysis stage, development stage, validation stage, evaluation, and dissemination, DCIRV research products can be recommended as a solution for expanding access, services, and adding digital learning communities throughout the archipelago and even internationally.

**Keywords:** Digital Central, Robotics Innovation, VCDLN, Artificial Intelligence, DCIRV.

The need for solving problems in education and learning services, both formal, informal and non-formal, even a number of education and training in government and private institutions is so urgent. Of course, from the conditions of the need for innovation and various new findings in more effective and efficient learning services will be the main demand, especially at the university level. Especially for a university that has a study program in the field of digitalization and Robotics instrumentation (Anđić et al., 2024), multimedia such as in the UPI Cibiru environment will be called to always find the latest innovations. This condition requires researchers to be ready to develop various innovations that are able to utilize the era of global digitalization, especially the era that is always identical to the adoption and innovation of the Artificial Intelligence work system (Gocen & Aydemir, 2020).

With the renewable resource and infrastructure capabilities owned by UPI Cibiru, efforts to solve problems and at the same time meet the needs of innovation in preparing and serving learning, the development of the Digital Central Innovation for Robotics VCDLN (DCIRV) has been designed. This innovation center is also intended as an answer to the sustainability of innovation that has previously been developed in the form of a central database, web-learning, and mobile learning based on Android and television technology known as VCDLN, (Darmawan, et al, 2021).

In the effort to develop DCIRV, of course, systematic stages are needed, both in terms of building design, rooms, equipment needed, and prototype design through appropriate 3D applications. After being designed, the research team will conduct a testing process both from competent experts and by conducting an explanatory survey. This stage is expected to be able to answer a number of challenges and objectives in this research problem, including: (1) How is the needs analysis in developing DCIRV?; (2) How is the development of the DCIRV model carried out?; (3) How is the DCIRV model product validated?; (4) How is the efficiency level of DCIRV in increasing the number of users?; (5) How are DCIRV research products disseminated systematically?

## Literature Review

a. Augmented Reality

In the context of the research that has been carried out, namely in the form of developing DCIRV which is a learning resource for serving distance learners mobile and virtual, as has been researched by (Hunt et al., 2021) about Virtual Peer-to-Peer Learning to Enhance and Accelerate the Health System Response to COVID-19: The HHS ASPR Project ECHO COVID-19 Clinical Rounds Initiative. One of the advantages of the research carried out is that it is also adapted to research findings regarding variants of augmented reality as aimed at strengthening research from (Tai et al., 2021) regarding Augmented reality-based visual-haptic modeling for thoracoscopic surgery training systems.

b. Virtual Reality

The advantage of the visual aspect in developing DCIRV lies in the service for learning that does not require synchronous presence in class (Peacock et al., 2012) namely regarding Exploring Tutor and Student Experiences in Online Synchronous Learning Environments in the Performing Arts. So the strength of DCV lies in asynchronous learning according to research from (Oluwaniyi et al., 2015) about the Development of an Asynchronous Web-Based E-Learning System, especially in nature virtual reality from (Gonzalez & Mohamad, 2022); (Wang & Wu, 2021) in his research on A virtual reality-based surgical skills training simulator for catheter ablation with real-time and robust interaction. The idea of the theoretical basis of VR is intended to provide learning services in nature Global Learning (King, 2017) digital throughout the wider region.

c. 3Dimensions of Learning

3D learning related to the development of robotics (Sarker et al., 2021) within the scope of DCIRV, specifically for services VCDLN-Learning (Darmawan, 2023) lies in the aspect of strength Visual Image and visual intelligence (Tan et al., 2012) for online teaching and learning (Maddock et al., 2022). The role of DCIRV which integrates the results of previous VCDLN-Learning innovations which are then accommodated by Digital Central Innovation Robotics will provide wider opportunities for educators in Indonesia and even internationally.

d. Robotics

Robotics adopted in the development of DCIRV is more about the aspect of the speed of promotional services and marketing of a number of its innovative products. For example, robotics that must be developed today is the robotics work system. (Anđić et al., 2024) which provides an opportunity to implement multidimensional

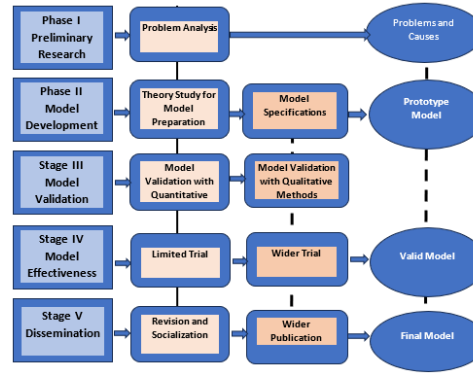
services for the needs of the education industry, as research from (Bianchi et al., 2023). Where this excellent service has been adopted by the VCDLN service work system (Darmawan, 2022). Understanding robotics itself refers to research findings from (King, 2017) about Personal Tacit Knowledge and Global Learning Professional Competencies—Multi-Dimensional Relationships.

e. Artificial Intelligence

In the DCIRV research study, the development model system offered is an advanced model that has been formulated in the context of VCDLN. Along with a number of developments in innovative products based on Artificial Intelligence (AI) supported by research findings from (Tan et al., 2012), Where from his research entitled Computer Science and Artificial Intelligence Laboratory Technical Report Throwing Down the Visual Intelligence Gauntlet Throwing Down the Visual Intelligence Gauntlet.

## Research Methodology

This study uses a mixed method approach with the R&D (Research and Development) method which is continued with a survey of users and product quality testing through expert judgment. The following are the stages of R&D with modified results according to (Borg, Walter R, and Gall, 1998) into 5 stages, namely: (1) Preliminary Research Stage, (2) Model Development Stage, (3) Model Validation Stage, (4) Effectiveness Test Stage, and (5) Dissemination Stage.




Figur.1 Research and Development for DCIRV

In processing data obtained during the design, development, testing and dissemination process, a statistical regression data analysis process is carried out. (Ding, 2006) to see the trend of the list of DCIRV prototype test-revision series which are assumed to be able to increase the score of the product test area.

## Results and Discussion

In this research, the DCIRV model development process was carried out through R&D steps and quantitative data processing, as stated above, as follows:

4.1 Preliminary Research Stage

At this stage, DCIRV is designed as a center for development and innovation in the fields of multimedia, robotics, and engineering of several software that are usually carried out in the computerization industry. This Data center is located in the New Building of the UPI Cibiru Campus which is built with a Smart Management System (SMS) nuance. Several preliminary studies that are rationally formulated starting from the SMS philosophy which are then linked to sustainable innovation with multi-year research that has had a Roadmap since 2016 in the Effort to build the Virtual Community Digital Learning Nusantara (VCDLN) which has been developed and disseminated at Unesco in 2021, 2022, and 2023 based on several reports

(Hennelly & Ctori, 2022a). The second preliminary study on the market opportunities of the DCIRV product will contribute to the research product in the form of an Android application. (Google Inc., 2015), IOS (Darmawan, 2020); (Sambhav & Verma, 2020; Sandström, 2011), dan Video (Rajadell & Garriga-Garzón, 2017; Wong & Lim, 2023) for learning that has industry standard value. The third preliminary study on opportunities for further development of DCIRV has challenges and roles in building regions, human resources, as well as access, equity, and quality governance automatically based on Robot Artificial Intelligence (Darmawansah et al., 2023);(Kong & Wang, 2019); (Hennelly & Ctori, 2022b) better in the future.

4.2 Model Development Stage

The development of the DCIRV model was carried out by following various trends in new theories about Robotics based on the framework of Artificial Intelligence. Among them is the theory of Joseph Engelberger which explains that Robots have an intelligence system (Control)(Cox, 2021; Teng et al., 2024). The intelligence system works by processing input data in the form of conditions or events that are happening from outside the environment. Furthermore, the system produces output in the form of instructions or decisions on the robot to perform a certain action. This system generally has a working principle like the brain in living things, which functions to think and decide what actions need to be taken at a certain time. Furthermore, it is also explained in the Merriam-Webster Dictionary, a robot is a machine that looks like a human and performs various complex actions from humans such as walking or talking, or a device that works automatically. The two theories about Robots, it is used as the basis for developing the DCIRV Model which adopts the Robot work system (Teng et al., 2024) especially the robot element, as explained in the Science that studies Robots or Robotics which explains that Robotics is a branch of science that studies robots. This branch of science includes robot machine design, electronics, control, computer programming, artificial intelligence, and so on. From the Branch of Science that is studied, there is an element of Artificial Intelligence in the world of Education (Anđić et al., 2024; Erdogan et al., 2023).

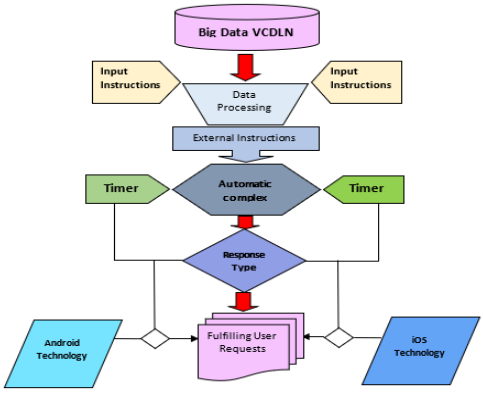



Figure 2 Multi-Platform Artificial Intelligence-based DCIRV Model Construction

From the model above, we get a DCIRV product, one of which is 3D Video Design.(Kwon et al., 2017; Moritz & Youn, 2022; Teplá et al., 2022) regarding the central innovation center which is capable of producing a wide range of learning service models in the form of Android-based mobile multiplatform VCDLNLearning and AppStore-based VCDLN-Learning.

4.3 Model Validation Stage

The Model Image above was assessed by Experts in the field of AI from Bordeaux University Professor Christine Pascal (2924) and Japan, namely Miyake Sensi, Sensi Kodama, and Doctor Indriyadi Rachman (2024) from Kitakyushu University, Mohammad Ridwan from McGill University and added 3 National Experts in the field of AI. Where for the latest technology trends this DCIRV product tends towards the use of Android and Appstore Technology, then after the recommended prototype model of the product produced is as

follows. The results from the expert who focused on the product in the image above produced the following:

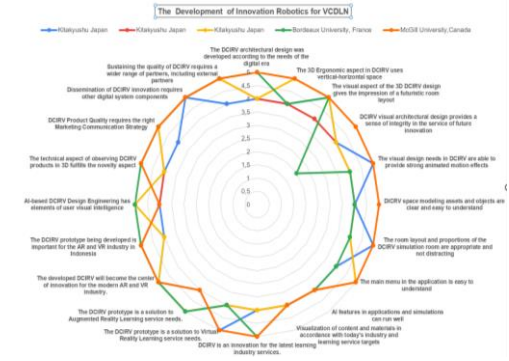



Figure 3 Expert Data from Canada, France, and Japan on DCIRV Research products

Based on the results of the expert data analysis that provided an assessment of the DCIRV research products presented during the FGD, the results showed very positive results. The assessment given by the expert moved from an average score of good and only one correction for the DCIRV assessment aspect regarding visual architectural (Bianchi et al., 2023) design provides a sense of integrity in the service of future innovation, given by experts from Bordeaux University-France and experts from Kitakyushu University, and McGill University. In the findings of this stage, some aspects are noted by experts regarding the visual 3D design of the DCIRV product, which is quite good and it is suggested that this discovery model is able to provide an impact on improving the AI framework. (Cukurova et al., 2020). As seen in Figure 3, it shows that all DCIRV assessment indicators consisting of 20 innovation indicators have an average score that satisfies the users who were the research sample at the validation stage of the findings model.

4.4 Effectiveness Test Phase

To test the level of effectiveness, it was carried out in the learning process carried out in one of the target research locations, namely in Jambi Regency, Merauke, Garut Regency, Bandung Regency, Denpasar, Banyuwangi, and East Kalimantan with the following results.:

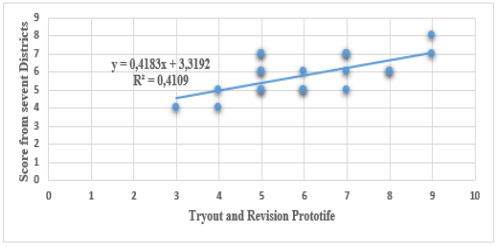



Figure 4 Measuring the level of effectiveness of DCIRV research products in seven districts/cities.

Based on the calculation results, the effectiveness level of the implementation of DCIRV research products in the product trial area shows calculation results that continue to show effectiveness data marked by an increasing linear regression line. Where when the DCIRV product trial was carried out and then revised according to input from stakeholders in the seven regions, during that time the scores given by respondents tended to be positive and increased in the aspect of expanding access to digital learning services. (Deni Darmawan, Dinn Wahyudin, Dian Rahadian, Andri Suryadi, 2022; Hennelly & Ctori, 2022b; Wong & Lim, 2023), the flexibility of learning services, as well as increasing the number of VCDLN-Learning communities as part of the DCIRV prototype product, these findings support research from (Darmawan, 2023; Deni Darmawan, Dinn Wahyudin, Dian Rahadian, Andri Suryadi, 2022; Wong & Lim, 2023). This increase can be seen in the resulting regression equation line, namely $y = 0,4183x + 3,3192$ with results $R^2 = 0,4109$. Thus, the increase in digital learning services through DCIRV is 41.1% in the Indonesian archipelago according to representatives of the districts and cities involved..

4.5 Dissemination Stage

The Dissemination Stage of DCIRV research products is carried out in a series of International

Cooperation research roadmaps, including workshop and webinar series activities in several districts. Dissemination is carried out to prospective product users, including educators, lecturers, teachers, students, stakeholders at the district and city levels, IT industry entrepreneurs, practitioners in the IT and Education fields, as well as school institutions, educational organizations, and professional organizations. The target areas for this dissemination include Jambi Regency, Merauke, Garut Regency, Bandung Regency, Denpasar, Banyuwangi, and East Kalimantan. The following is a map of the number of target prospective users of DCIRV research products from the seven districts/cities.

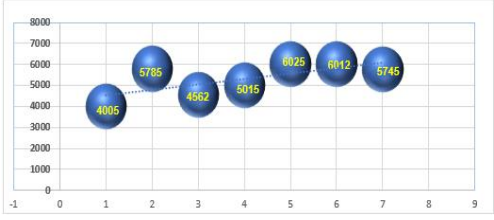



Figure 5 Data Dissemination Research Products of DCIRV in Seventh District

From the data from the Dissemination results that have been carried out both online and offline in seven districts/cities that have been carried out in this study, the results show a trend of increasing scores and an increase in members using DCIRV innovation products through VCDLN-Learning. This finding supports research from (Gonzalez & Mohamad, 2022; King, 2017; Oluwaniyi et al., 2015; Sattayaraksa et al., 2023) The large number of people interested in using this DCIRV research product is inseparable from the superiority of the product based on the results of Experts from research partners from Bordeaux University France, MC. Gill Canada and Kitakyushu Japan.

AI-based DCIRV Design Engineering Products have elements of user visual intelligence, especially those that have been produced by the DCIRV research team, where the Technical Aspect of observing DCIRV products in 3D form fulfills the novelty aspect that is migrated into the Mobile Appstore and Android, as an effort to support research from (Ningsih & Adesti, 2020; Ulfa et al., 2017). Furthermore, from the aspect of product quality, DCIRV certainly requires an appropriate marketing communication strategy. (Al-Gharaibeh, 2016; Trihastuti & Zamzani, 2018). In this marketing process, the research team has carried out several promotions in regions in the archipelago, around 20 districts and cities representing Eastern, Central, and Western Indonesia.

From the results of the Dissemination Efforts of DCIRV innovation products, it is expected to be able to realize the target of Sustainable Product Quality. Where so far in the implementation of this dissemination is also supported by extensive partners including from abroad. The following is the data on the results of the dissemination of DCIRV product quality which is able to improve the visual intelligence aspect of users with AppStore and Android Technology (Ulfa et al., 2017). In practice, this DCIRV research product still requires a marketing communication strategy to disseminate and attract potential user markets.

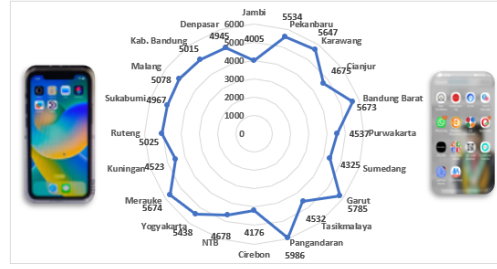



Figure 6 Dissemination of DCIRV through the Appstore Mobile App

In the above image, after the research produced an Appstore application that can be downloaded and installed on an IOS Mobile Phone, the DCIRV research product can be easily accessed by several Generation-z users. This finding supports research from (Fojtik,

2017; Gábor & Péter, 2015). This was done through the dissemination of product trial results by experts from Japan, Canada, and Bordeaux Francis who gave their opinions after a fairly ideal assessment of the Indonesian archipelago, this opinion is in accordance with the findings of (Chóliz, M., Marco, J. H., & Carbonell, 2020; Gábor & Péter, 2015). Where the results can be seen from the data in Figure 6. The findings, it show a very rapid increase in terms of using research products in the form of DCIRV based on the Mobile Appstore.

## Conclusion

All stages of research on the development of the DCIR product model, it show the credibility of the research product starting from the first stage, namely the preliminary study to construct a research product that is very relevant to the needs of the digital era, especially in the field of education. The second stage, namely the model formulation stage, shows that the DCIRV product model, both Android and Appstore-based, is very relevant to users' needs, and has an adaptive digital mobile character. The third stage, namely the validation of the DCIRV research product, has been carried out by involving experts from the AI field from Mitra Universitas Dunia elements of the application of AI and other AI frameworks such as Neural Networks and Robotics are reflected in this research product. The fourth stage, namely the effectiveness test stage, shows that the DCIRV product has provided a trend of increasing attraction, expanding access, digital learning services, and increasing the number of digital learning communities in the archipelago. The fifth stage, namely the dissemination stage, shows the condition that the innovation of the DCIRV research product which has the opportunity for access through the IOS and Android multi-platforms has been able to touch the expansion of the region and members in the utilization of services and product content from DCIRV by 20 Regencies/Cities in Indonesia. The findings of this research have been able to be recommended as a strategy for developing large digital learning communities in Asia, Europe, and Canada.

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