

# Adaptive learning system in open educational resource digital sharing community as a media for learning autonomous students

H Elmunsyah<sup>1,\*</sup>, W N Hidayat<sup>1</sup>, S Patmanthara<sup>1</sup>, F A Dwiyanto<sup>1</sup>, W M Utomo<sup>2</sup>  
and K Kusumadyahdewi<sup>3</sup>

<sup>1</sup> State University of Malang, Malang, Indonesia

<sup>2</sup> Universiti Tun Hussein Onn, Malaysia

<sup>3</sup> State Islamic University of Maulana Malik Ibrahim Malang, Malang, Indonesia

\*hakkun@um.ac.id

**Abstract.** In the disruptive era, online learning models began to be widely developed. Malang State University as one of the state universities in Indonesia is developing and implementing a new curriculum with the theme of Life-Based Learning (LBL) as a form of adaptation in facing the Industrial 4.0 era. Through LBL, college graduates are expected to not only master competencies, but be able to develop their abilities to be able to face the needs and developments of the industrial revolution era 4.0. This study aims to develop an LMS-based transdisciplinary learning portal supported by internet and mobile technology. The product developed is reinforced with additional features in the form of Adaptive Learning System (ALS) in the digital sharing community (DSC) learning portal which is expected to be able to improve student capabilities. The development procedure model used in this study is to use the 4D model suggested by Thiagarajan and its requirements such as design analysis, validation and determination of research subjects. The steps in this model are the four stages of development, namely define, design, develop, and disseminate. Based on the overall analysis of the results of data collection it can be concluded that the results of the product feasibility trial, obtain very decent results. The details of the feasibility results were obtained from media experts 97.91%, material experts 96.33 %, small groups with 30 user users obtained 90.85% and large groups with 134 users obtained 94.25%. Based on these results it can be concluded that the ALS products on DSC for learning can be categorized as very appropriate to be used for the learning process, because the results obtained are above 85%.

## 1. Introduction

In the current development of information and communication technology (ICT), a learning process is no longer traditionally done by face-to-face in a classroom. It transform to a future education paradigm known as 21<sup>st</sup> century learning [1]. This learning concept means that every person can learn anytime and anywhere such as home, library, industry, and so on. Moreover, it allows to learn with everyone and with any learning sources such as books, magazine, newspaper, internet, learning management system (LMS), and so on [2–4].

Currently, the curriculum and learning in a higher education still has a several problems. Especially, related to the preparation of a human resources in a 21<sup>st</sup> century. The recent development of a 21<sup>st</sup> century



Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

learning faces a four main challenges namely, industrial revolution 4.0, globalization, domestic needs, and Z-generation [5,6]. A society life which is more complex, no distance, and global requires a proper science and technology. It is not only the depth of a substance, but also the problem-solving strategy. Therefore, the curriculum and learning which prepare a human resource should adapt with that. To face these challenges, it needs holistic and comprehensive thinking by optimizing the potential of multiple intelligences, sensitivity in utilizing varied learning resources, and heterogeneous classroom learning strategies.

There are paradigm changes in a curriculum and learning development in a higher education to prepare a 21<sup>st</sup> human resources [7]. A curriculum is not separately organized, but integrated. An approach to organize that curriculum is a transdisciplinary, which is integrated several scientific fields to solve a complex problem. Moreover, to anticipate a 21<sup>st</sup> skills disruption, a transdisciplinary learning strategy need to consider various aspects, not only a content and learners' characteristics, but also a learning innovation that are appropriate to the millennial era.

There are some transdisciplinary learning strategies which can learned independently as a learning innovation [8]. One of the strategy is a development of digital sharing community (DSC) based on adaptive learning system (ALS) [9]. The basic idea of DSC is the importance of developing an existing online learning system into an online system with intelligent computing which can adapt the learning presentation with the students' characteristics. The study and development of DSC intended as a part of a researchers' roadmap that focused on learning innovation and ICT-based learning.

On the other hand, the smartphone sales have significantly increased over the past few years. In 2009, the number of worldwide sales has reached up to 170 million. In 2015 it increased more than 1.4 billion, and it is estimated that more than one third of the world's population own a smartphone in 2017. Furthermore, the number of smartphone users is expected to pass 2.6 billion for the first time in 2019. According to statista.com, the global smartphone sales from first quarter of 2009 to the second quarter of 2018, showed a significant increase [10]. This statistic shows global smartphone sales for end-users based on the operating system used. Indonesia as a developing country certainly cannot be separated from smartphone utilization as social and information media. The 250 million of Indonesia population is a large market for a smartphone sale. According to the eMarketer, in 2018 the active smartphone user in Indonesia are more than 100 million.

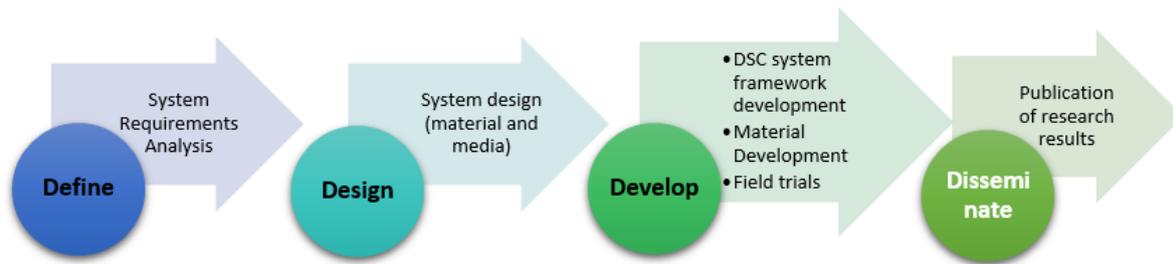
Based on the description, this study will develop a DSC transdisciplinary online learning platform based on ALS to improve a service an online learning quality. The system will be developed in a mobile apps as a user choice. In addition, with an intelligence system in a DSC user expected can be more interest and feel comfortable while learn with it.

## 2. Method

The development model used in this study is 4D that consist of define, design, develop, and disseminate. Figure 1 shows the basic concept of 4D development model. This model selected to develop a DSC transdisciplinary online learning platform based on ALS to improve a service an online learning quality. Then, a developed product will be tested the feasibility using validity and product trials to find out a user's perception about the media.

The selection of this model based on a systematic considerations and rests on the theoretical basic of learning. This model is programmed in a systematic activity as an effort to solve learning problems related to a learning resource. It based on a user needs and learning characteristics, which in this case are student of electrical engineering department, State University of Malang.

The initial design or a prototype made from the results of a draft preparation of material and media. Then, a development stage conducted with a production and validation from material and media expert. The experts are tasked to analyze and evaluate the media and carried out the first and second revision. After a revision stage, then a product trials conducted in a small and large scale to analyze and evaluate the media.



**Figure 1.** Procedure of developing Digital Sharing Community (DSC) based on Mobile Application

This research using quantitative analysis with a percentage technique and qualitative descriptive. To conduct a quantitative analysis, researchers must be able to understand the statistical forms used in research before starting a data analysis.

### 2.1. Expert Validation

This research using a quantitative data analysis technique. A data obtained from the validator is analyzed by a qualitative descriptive and used as a reference to revise a product. The developed product design is rated by validator using validation sheet. The result of all aspects is measured in a Likert scale.

The next step is to measure the media feasibility, a data is analyzed using following equation. Where,  $\bar{x}$  is an average score,  $n$  is a total evaluator, and  $\sum x$  is a total score.

$$\bar{x} = \frac{\sum x}{n} \quad (1)$$

Then, for the percentage results can be calculated with the following equation.

$$\text{Result} = \frac{\text{Total gained score}}{\text{Maximum score}} \times 100\% \quad (2)$$

### 2.2. Student Perception Analysis

Student perception were obtained using a Likert scale. The assessment guidelines of a student perception with categories (1) very less; (2) less; (3) good; and (4) very good.

The results of student perception in the form of a questionnaire were analysed with the several steps. First is to make a recapitulation of the results of the questionnaire regarding student perception using the product. Then, calculate the percentage of student's responses. Data were analysed using equation 1. Then for the percentage of results can be calculated with the equation 2.

## 3. Result and discussion

On the define stage, researchers get the concept of media utilization that is a development requirement. The researchers can set and define the requirements of learning, so they are able to analyse several goals and what are the obstacles that occur in learning through five main steps, namely the front-end analysis, student analysis, task analysis, concept analysis, and formulation of learning objectives.

In a front-end analysis stage, observations were made in several study programs in the Department of Electrical Engineering, State University of Malang. Researchers draw a conclusion about the tasks of lecturers and students that use a developed learning media, to obtain an information and abilities in terms of knowledge and skills. Furthermore, (1) a student analysis to discover the background knowledge of students; (2) Analysis of students' cognitive development; student analysis where a researcher looks at and examine student characteristics based on requirements; (3) Concept Analysis; (4) Task Analysis; and finally examine the specified learning objectives.

On a design stage, a several steps have been carried out. The first step is a constructing criterion-referenced test. This stage connects the define stage with the design stage. This test arranged by adjusting students' cognitive abilities. In addition, the evaluation in the developed learning media to guidance of learning media system can be downloaded at [bit.ly/PanduanALS](http://bit.ly/PanduanALS).

The second step is a media selection. It aims to identify a learning media that relevant with a material characteristic and student's requirements. Web-based cropipd learning media selected to utilize a PC or a laptop in a laboratory as a learning media. In addition, an apps that support a developed media such as sublime text, MinGW developer studio, Adobe Flash, Adobe Photoshop, Corel Draw, and XAMPP.

The third step is a format selection. This is done so that the selected format is suitable with the learning material. The selected presentation is adjusted to the learning media used. The selected format in development is intended by designing learning content, approaches, learning resources, organizing and designing media content, and making media designs that include layout designs, drawings, and writing.

The next step is making an initial design. A preliminary design of web-based interactive crossword puzzle basic programming (cropipd) shown at Figure 2 and Figure 3. It can be accessed on <http://learninginnovation.web.id/dscv3/>.

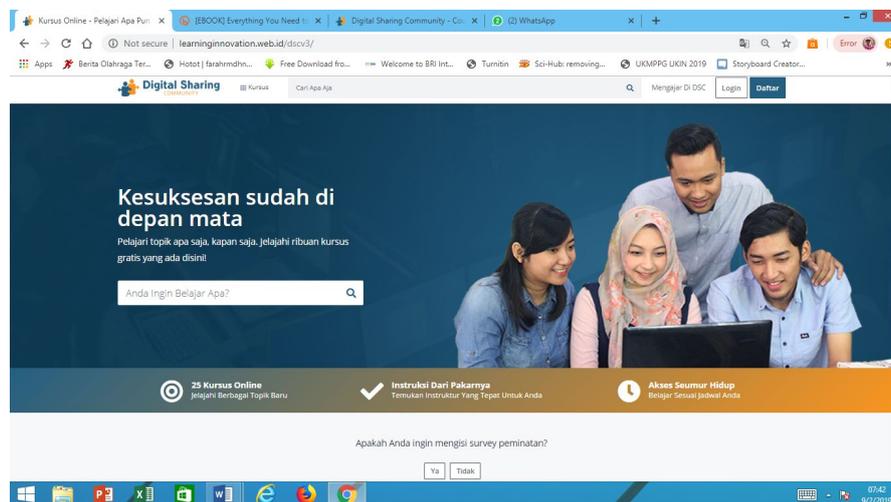


Figure 2. Main page preview.

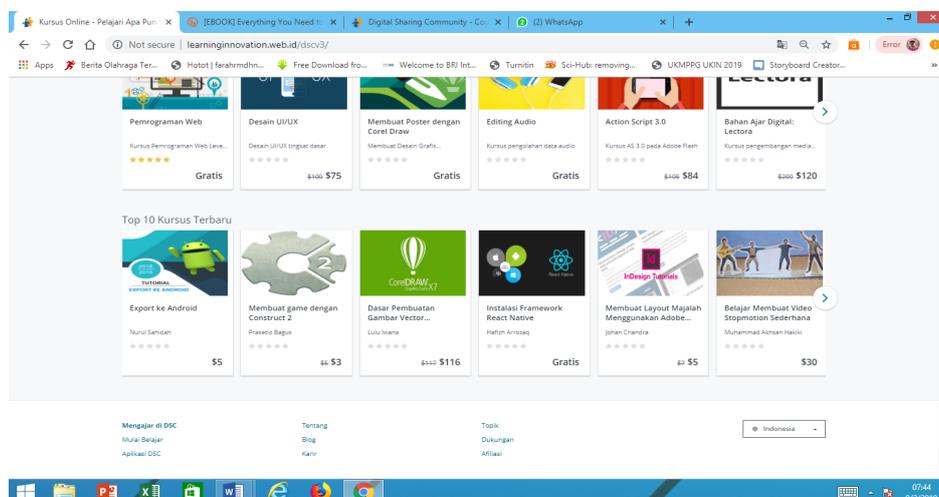


Figure 3. Provided learning topics in DSC.

### 3.1. Expert validation

The design of the prototype learning media that has been prepared at the design stage, will be assessed or validated by validator experts. The validators are experts who competent in the field of basic programming materials and understand about the preparation of instructional media and are able to provide critics or suggestions for improving the instructional media. This validation is carried out to determine the validity and quality of the developed learning media. Validation is done by using an instrument sheet. The validation of experts in this development consists of two lecturers and one teacher of basic programming subjects.

### 3.2. Result and analysis of validation data

Media expert validation is used to improve and obtain a suggestion for learning media. It aims to produce a learning media that is feasible to apply and use in a learning process. The data recapitulation then analyzed to determine the results of the validation of media experts to the learning media. Following are the results of data analysis from the validation instrument recapitulation.

**Table 1.** Data recapitulation from media expert validation.

Aspects	Percentage %	Category
Programming	97,14	Very feasible
Interface	98,67	Very feasible
Average	97,91	Very feasible

Based on Table 1, it can be seen that each indicator has the different value, with a total overall score of 97.91%. So, it can be concluded that the recapitulation results of the adaptive learning system (ALS) data validation on the DSC have met the very feasible criteria for use in learning activities. Media expert validation is used to improve existing learning material based on the suggestions and in accordance with the needs of end users.

**Table 2.** Data recapitulation from material expert validation.

Aspects	Percentage %	Criteria
Material	95	Very feasible
Learning	98	Very feasible
Language	96	Very feasible
Average	96,33	Very feasible

Based on Table 2, it can be seen that each indicator has a different value, with a total average score of 96.33%. So, it can be concluded that the material contained in adaptive learning system (ALS) on the DSC have met the criteria very feasible to be tested.

### 3.3. Product testing

After the product validation of learning media, the learning media will be tested to the user. The tests consist of two tests namely small and large groups. 30 students involved in a small group test to find out the results of the learning media. The test aimed to obtain input and suggestion for revision to be the final result of the media that can be disseminated. A data recapitulation then analyzed to find out the students' responses to the media.

Based on Table 3, it can be seen that from 30 students as an object produced an average percentage for the aspects of language, programming, Interface, and implementation as 90.85% with the category very feasible. From the results of the students' response data analysis, then the developed ALS is stated good and agreed to be used in a learning activity. The results of this test will be used to revise and refine it so that the learning system is ready to be used on a large-scale test.

**Table 3.** Students' responses to an ALS in a small group test.

Aspects	Percentage %	Criteria
Language	92.50	Very feasible
Programming	90.00	Very feasible
Interface	92.40	Very feasible
Implementation	88.50	Very feasible
Average	90.85	Very feasible

After the product revision, a large test conducted in order to produce a final product which can be disseminated. The final test aims to find out the feasibility in a larger scale and obtain a suggestion to improve the learning media. The final test involving 134 students of electrical engineering department, State University of Malang. Table 4 shows the result of the large test.

**Table 4.** Students' responses to an ALS in a large group test.

Aspects	Percentage %	Criteria
Language	91.70	Very Good
Programming	96.63	Very Good
Interface	97.43	Very Good
Implementation	91.25	Very Good
Motivation	93.53	Very Good
Average	94.25	Very Good

Based on Table 4, all the aspects show in a very good criterion. It means that the ALS is in good condition, and ready to be disseminate. In the dissemination process as a final stage of the 4-D model, it conducting the diffusion, promotion, and distribution of development products. It aims so that the ALS can be accepted by users, both individuals, groups and systems. At the dissemination stage is carried out with the socialization of learning system through the distribution in a limited number to several study programs in the Electrical Engineering department, namely the Electrical Engineering Education and the Informatics Engineering Education. Distribution is only done as a product publication, is not commercial, and only reaches the effectiveness and feasibility test of the ALS based on DSC. The results of this feasibility are in line with the results of data processing from previous studies which revealed that student satisfaction in using learning media, has an influence to encourage achievement and passion in learning.

#### 4. Conclusion

Based on the preliminary results, it focusing on education problems that occur the disruptive era and the paradigm of generation Z in a 21<sup>st</sup> century. Therefore, it needs to develop an LMS-based transdisciplinary learning portal supported by internet and mobile technology. Product development results at <http://learninginnovation.web.id/dscv3/home> are reinforced with additional features in the form of Adaptive Learning System (ALS) which are expected to improve student capabilities. This research stage was developed by adaptive hints based on Artificial Intelligence in Digital Sharing Community (DSC) through questionnaires that lead users to choose the appropriate material. Through the three stages of test subjects namely expert trials, limited group trials and field trial subjects, feasibility criteria are obtained in the very feasible category.

#### 5. Acknowledgment

This research was supported by LP2M-UM that approve and provide a funding through a grant PNBPU-UM 2019. We thank our colleagues from State University of Malang who provided insight and expertise

that greatly assisted the research, although they may not agree with all of the interpretations/conclusions of this paper.

### References

- [1] Spector J M, Ifenthaler D, Sampson D, Yang L (Joy), Mukama E, Warusavitarana A, Dona K L, Eichhorn K, Fluck A, Huang R, Bridges S, Lu J, Ren Y, Gui X, Deneen C C, Diego J S and Gibson D C 2016 Technology enhanced formative assessment for 21st century learning *J. Educ. Technol. Soc.* **19** 58–71
- [2] Wang Q, Woo H L, Quek C L, Yang Y and Liu M 2012 Using the Facebook group as a learning management system: An exploratory study *Br. J. Educ. Technol.* **43** 428–38
- [3] Limongelli C, Lombardi M, Marani A, Sciarrone F and Temperini M 2016 A recommendation module to help teachers build courses through the Moodle Learning Management System *New Rev. Hypermedia Multimed.* **22** 58–82
- [4] Orfanou K, Tselios N and Katsanos C 2015 Perceived usability evaluation of learning management systems: Empirical evaluation of the System Usability Scale *Int. Rev. Res. Open Distrib. Learn.* **16** 227–46
- [5] Balyer A and Oz O 2018 Academicians' view on digitl transformation in education *Int. Online J. Educ. Teach.* **5** 809–30
- [6] Jones V, Jo J and Martin P 2007 Future Schools and How Technology can be used to support Millennial and Generation-Z Students *ICUT 2007 (Proc. B), 1st Int. Conf. Ubiquitous Information Technology* pp 886–91
- [7] Hashim M and Hameed F 2012 Human resource management in 21st century: issues & challenges & possible solutions to attain competitiveness *Int. J. Acad. Res. Bus. Soc. Sci.* **2** 44
- [8] Fortuin K P J and Van Koppen C S A 2016 Teaching and learning reflexive skills in inter-and transdisciplinary research: A framework and its application in environmental science education *Environ. Educ. Res.* **22** 697–716
- [9] Truong H M 2016 Integrating learning styles and adaptive e-learning system: Current developments, problems and opportunities *Comput. Human Behav.* **55** 1185–93
- [10] Holst A 2019 Global smartphone sales by operating system 2009-2018, by quarter *Technol. Telecommun.*