Improving Student Academic Performance Through Web Base Learning

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Abstract

The development of digital technology has triggered changes in the way people learn in various educational institutions, both formal and informal. The development of digital technology has encouraged students to improve their academic performance or learning achievements. Several problems, however, can arise, from the gap in the ability of students to master digital technology, the ability to provide technological infrastructure, the competence of top-level management and the ability of the IT department to determine the success of digitalization. One of the learning models that can be utilized in implementing the use of digital technology is Web-Based Learning (WBL). WBL is a learning model that can be used without limitation of time, space, and learning resources. WBL was developed by using the Research and Development (RnD) with a 4D (Define, Design, Develop, Disseminate) approach. To develop WBL products, we used the unified modeling language (UML), flowcharts, and context diagrams. The product was tested which included product validity testing, practicality testing, and product effectiveness testing. The testing results showed that the product was valid, practical, and effective to be used as a guide for developing and implementing WBL in order to improve students' academic performance.

Keywords : Architecture Design Education, Academic Performance, Digital Informal Learning, Learning Model, Web-Based Learning

Abstrak

Perkembangan teknologi digital menjadi salah satu pemicu percepatan perubahan cara belajar di berbagai lembaga pendidikan, baik di Lembaga Pendidikan formal maupun informal. Perkembangan teknologi digital telah mendorong peserta didik memanfaatkan teknologi tersebut untuk meningkatkan kinerja akademik atau prestasi belajar mereka. Ketika penggunaan teknologi digital dalam pembelajaan diimplementasikan, beberapa permasalahan muncul, diantaranya kesenjangan kemampuan peserta didik dalam menguasai teknologi digital, ketersediaan infrastruktur teknologi yang terbatas, hingga kompetensi top level management yang tidak begitu baik dan masih rendahnya kemampuan bagian IT dalam menentukan keberhasilan digitalisasi. Salah satu model pembelajaran yang dapat dimanfaatkan dalam implementasi penggunaan teknologi digital adalah Web-Based Learning (WBL). WBL merupakan model pembelajaran yang dapat digunakan tanpa batasan waktu, ruang, dan sumber belajar. WBL dikembangkan dengan menggunakan pendekatan Research and Development (RnD) dengan pendekatan 4D (Define, Design, Develop, Disseminate). Untuk mengembangkan produk WBL, peneliti menggunakan unified modeling language (UML), flowchart, dan context diagram. Produk yang dihasilkan diuji yang meliputi uji validitas produk, uji praktikalitas, dan uji efektivitas produk. Hasil pengujian menunjukkan bahwa produk valid, praktis dan efektif untuk digunakan sebagai panduan pengembangan dan implementasi WBL dalam rangka meningkatkan prestasi akademik peserta didik..

***Kata Kunci** : Desain Arsitektur Pembelajaran, Kinerja Akademik, Pembelajaran Digital Non-Formal, Model Pembelajaran, Pembelajaran Berbasis Web*

Introduction

Information technology has triggered developments in all aspects of life, including developments in the world of education[1]. Many educational institutions have been implementing ICT in learning. One of the triggers for accelerating the implementation of ICT in learning is the spread of the Corona virus disease or the so-called Covid-19, changing the pattern of almost all human activities in at least two years. Learning activities were also affected. The government's policy of social distancing and physical distancing forced policy makers in the education sector to impose learning from home arrangements using a variety of online learning media. One such example was the policy of the Norwegian government[2].

Oslow University, Norway, only took one week to prepare for the transformation of classroom learning to digital learning[3]. There were at least three aspects that were the main factors for the success this transformation. First, the strength and courage of top leader management; second, the ability of the ICT team; and third, the support of lecturer resources and education staff who have competence in the field of ICT[4]. Thus, facilitating coordination and communication between these stakeholders ran very quickly and effectively.

After the easing of the spread of COVID-19, of course, the implementation of ICT will not disappear, given the enormous contribution of ICT to the students' academic performance[5]. Academic performance is not only influenced by formal learning but is also influenced by informal learning[6]. Formal learning is carried out in a directed, systematic manner by formal educational institutions[7]. Formal learning is usually used to obtain recognition or diplomas for competencies[8]. Informal learning is carried out without a clear curriculum or planning and is not used to obtain official recognition[9].

One of the appropriate learning models to support formal learning is informal learning. More precisely, this involves Web-Based Learning (WBL) which is an integrated software or program that automates the administration of online learning, tracking, and reporting systems. WBL provides a centralized management approach to learning systems in scheduling and organizing students, learning activities, and learning outcomes assessment[10]. WBL represents a multiuser environment where learning developers can create, store, reuse, manage, and send digital learning content from primary storage[11]. In line

[1] Mahboobe Mehrvarz and others, 'The Mediating Role of Digital Informal Learning in the Relationship between Students' Digital Competency and Their Academic Performance', *Computers and Education*, 167.June 2020 (2021), 104184 <https://doi.org/10.1016/j.compedu.2021.104184>.

[2] Bendik Bygstad and others, 'From Dual Digitalization to Digital Learning Space: Exploring the Digital Transformation of Higher Education', *Computers and Education*, 182.August 2021 (2022) <https://doi.org/10.1016/j.compedu.2022.104463>.

[3] Bygstad and others.

[4] Bygstad and others.

[5] Jaehee Jeon and Sisook Kim, 'The Mediating Effects of Digital Literacy and Self-Efficacy on the Relationship between Learning Attitudes and Ehealth Literacy in Nursing Students: A Cross-Sectional Study', *Nurse Education Today*, 113.April (2022), 105378 <https://doi.org/10.1016/j.nedt.2022.105378>.

[6] Jung-Sook Lee, 'The Relationship Between Student Engagement and Academic Performance: Is It a Myth or Reality?', *The Journal of Educational Research*, 107.3 (2014), 177–85 <https://doi.org/10.1080/00220671.2013.807491>.

[7] Eric M. Meyers, Ingrid Erickson, and Ruth V. Small, 'Digital Literacy and Informal Learning Environments: An Introduction', *Learning, Media and Technology*, 38.4 (2013), 355–67 <https://doi.org/10.1080/17439884.2013.783597>.

[8] Betül C Czerkawski, 'Blending Formal and Informal Learning Networks for Online Learning', *International Review of Research in Open and Distributed Learning*, 17.3 (2016) <https://doi.org/https://doi.org/10.19173/irrodl.v17i3.2344CopiedAn error has occurred>.

[9] Czerkawski.

[10] Bambang Hariadi, 'Web-Based Cooperative Learning, Learning Styles, and Student'S Learning Outcomes', *Jurnal Cakrawala Pendidikan*, 53.2 (2015), 160–70 <https://doi.org/10.1017/CBO9781107415324.004>.

[11] a.M. Alkouz, 'Web Services Based Learning Objects Generator for Device-Independent M-Learning', *International Journal of Emerging Technologies in Learning*, 2006, 1–3.

with the above definition[12] WBL is a software application for administration, documentation, tracking, reporting, and delivery of online learning. According to Azizi (2016)[13] Web-Based Learning is an information technology product that can be used by professors and students to facilitate interaction and learning presented on the website. All contents, updates, and activities are posted to this system, and students can manage interactions through messages, e-mail, and online forums. According to Ülker & Yılma (2016)[14] Web-Based Learning is a web-based system that allows instructors and students to share subject matter, make class announcements, submit and return learning assignments, and communicate with each other online.

Web-Based Learning is a learning management software package that supports various social and environmental conditions such as at the home, public spaces, and classes with a variety of interaction facilities such as e-mail, forums, chat, where the user interaction system is presented on the website[15]. Based on the above definition WBL can be described as follows:

Figure 1. Definition of Web-Based Learning[16]

Some of the activities that can be carried out in the WBL include searching for information (books, bibliography, encyclopedias, programs, etc.), distribution of educational material (texts, programs), providing curriculum and study guides, and training in the desired format[17], such as hypertext, audio, video, forming collaborative activities (group discussions via e-mail and mailing lists), frequently asked questions, tutorials, and simulations[18]. Through Web-Based Learning, productivity can be increased[19], for example, travel time can be reduced so students and lecturers would not lose time due to travel activities that must be carried out for learning activities. WBL can be carried out from any location as long as there is a connection to the source of knowledge[20]. Learning classes do not prioritize physical form anymore because all activities can use internet applications[21]. WBL can accommodate the entire learning process, starting

[12] (Wihastyanang, Hentasmaka, & Anjarwati, 2014:2)

[13] (Azizi, 2016:2112)

[14] (Ülker & Yılma, 2016:20)

[15] Supratman Zakir and Hidayat Rahmat, 'Web-Based Learning Model That Can Be Implemented in Learning Settings Without Being Limited by Time , Place and Space', *Journal of Theoretical an Applied Information Technology*, 96.23 (2018), 7996–8005.

[16] Oenardi Lawanto, 'Pembelajaran Berbasis Web Sebagai Metoda Komplemen Kegiatan Pendidikan Dan Pelatihan*', *Unitas*, 9.1 (2000), 44–58.

[17] Demei Shen and others, 'Unpacking Online Learning Experiences: Online Learning Self-Efficacy and Learning Satisfaction', *Internet and Higher Education*, 19 (2013), 10–17 <https://doi.org/10.1016/j.iheduc.2013.04.001>.

[18] Alif Ringga Persada, 'Peningkatan Hasil Belajar Matematika Melalui Pengembangan Bahan Ajar Berbasis Website', *EduMa*, 6.1 (2017), 62–76 <https://doi.org/10.24235/eduma.v6i1.1661>.

[19] Supratman Zakir, Sarjon Defit, and Vitriani, 'Indeks Kesiapan Perguruan Tinggi Dalam Mengimplementasikan Smart Campus', *Jurnal Teknologi Informasi Dan Ilmu Komputer (JTIIK)*, 6.3 (2019), 267–76 <https://doi.org/10.25126/jtiik.20196986>.

[20] Wan Ng, 'Can We Teach Digital Natives Digital Literacy?', *Computers and Education*, 59.3 (2012), 1065–78 <https://doi.org/10.1016/j.compedu.2012.04.016>.

[21] Alesia Mickle Moldavan, Christine Edwards-Leis, and Jennifer Murray, 'Design and Pedagogical Implications of a Digital Learning Platform to Promote Well-Being in Teacher Education', *Teaching and Teacher Education*, 115 (2022), 103732 <https://doi.org/10.1016/j.tate.2022.103732>.

from registration, matriculation, discussion, and evaluation.[22] [23]

WBL can empower students to be responsible in learning[24]. Students can also get guidance and assistance from lecturers, tutors, resource persons, colleagues who are far apart[25]. Learning materials will be more consistent, systematic, and organized, making it easier for students to follow the learning modules[26]. The search, evaluation, and administration of student learning outcomes are more organized and easily obtained[27]. A study by Bartlett, Michelle E, Bartlett, and James E, showed that WBL is a learning model that has effectiveness in its implementation[28]. Supratman Zakir and Rahmat Hidayat stated that WBL can be carried out without being limited by space, time, place[29].

WBL can be developed using a Content Management System (CMS) or by developing the WBL application independently. WBL development can be assisted with several system development tools or tools such as the Unified Modeling Language (UML). UML (Unified Modeling Language) is one of the language standards that is widely used in the industrial world to define requirements, make analysis and designs, and describe object-oriented programming architectures. UML was developed as object-oriented analysis and design tool by Gardy Booch, Jim Rumbaugh, and Ivar Jacobson.[30]

UML is one of the language standards in visual modeling methods, as an object-oriented programming design and analysis tool for understanding and documenting every information system.

a) Use Case Diagram

Use Case diagram is modeling for the behavior of the information system that will be developed. Use Case describes an interaction of one or more actors with the information system that will be developed. Use Case is used to find out what functions are in an information system and who has the right to use those functions.

The naming requirements in the Use Case must be defined as simple as possible and can be understood. There are two main things in Use Case, namely the actor and Use Case. Actors are people, processes, or other systems that interact with information systems that will be developed, so even though the symbol of an actor is a person, an actor is not necessarily a person. Use Case is a functionality provided by the system as units that exchange messages between units or actors.

b) Activity Diagram

Activity Diagram illustrates the workflow or activity of a system or business process or menu in the software. The activity diagram illustrates system activity not actor activity.

[22] Ludmila Kuklina and Sergey Kuklin, 'Web Content as a Base Component of the Educational Environment', in *SHS Web of Conferences* (Moscow, Russia: EDP Sciences, 2016), 02023, 0–3 <https://doi.org/10.1051/shsconf/20162902023>.

[23] Supratman, Toni Arianto, and Efmi Maiyana, 'Development of Local Web-Based Learning (LWBL) as Low-Cost Digital Learning Efforts', *Journal of Physics: Conference Series*, 1471.1 (2020) <https://doi.org/10.1088/1742-6596/1471/1/012003>.

[24] Donnie Johnson Sackey, Minh-Tam Nguyen, and Jeffery T Grabill, 'Constructing Learning Spaces: What We Can Learn from Studies of Informal Learning Online', *Computers and Composition*, 35 (2015), 112–24 <https://doi.org/https://doi.org/10.1016/j.compcom.2015.01.004>.

[25] Antonio Calvani, Antonio Fini, and Maria Ranieri, 'Assessing Digital Competence in Secondary Education. Issues, Models and Instruments', *Issues in Information and Media Literacy: Education, Practice and Pedagogy*, 2 (2009), 153–72.

[26] Jérôme Hutain and Nicolas Michinov, 'Improving Student Engagement during In-Person Classes by Using Functionalities of a Digital Learning Environment', *Computers and Education*, 183.August 2021 (2022) <https://doi.org/10.1016/j.compedu.2022.104496>.

[27] Irfan Rifai, 'Designing Content For A Web-Based Application Used In Blended Composition Classes: Things To Consider In The EFL/ESL Context', *Humaniora*, 5.2 (2014), 1049–55.

[28] Michelle E Bartlett and James E Bartlett, 'Case Study on the Impact of Technology on Incivility in Higher Education', *The Journal of Educators Online*, 13.2 (2016), 1–18.

[29] Zakir and Rahmat.

[30] Supratman Zakir, 'Modernisasi Administrasi Usaha Kecil Menengah (Ukm) Melalui Pemanfaatan Sistem Informasi', *Proseding Seminar Nasional Asosiasi Perguruan Tinggi Ilmu Komputer (APTIKOM)*, 1.1 (2016) <https://doi.org/10.5281/zenodo.241507>.

The activity diagram is also widely used to define things such as business process design where each sequence of activities described is a business system defined process, sequence or grouping of views of the system/user interface where each activity is considered to have a display interface design, test design where each activity is considered to require a test that needs to be defined and the menu design displayed.

Web-based learning is one form of 21st century learning, therefore the competence of educators and participants related to web-based learning is very important to be improved continuously, one of which is by developing or designing a web-based learning architecture, so that it can be used as a reference in the context of developing learning that leads to improved student learning outcomes or student academic performance.

Method

This study used the Research and Development (R&D) approach which is a process of developing a new product or improve existing products that can be accounted for and whose effectiveness can be tested[31]. This study used 4D (Define-Design-Develop-Disseminate) Research and Development (R&D).

The 4D version of Research and Development (R&D) is oriented to the product by finding, developing, and validating the product[32] [33].

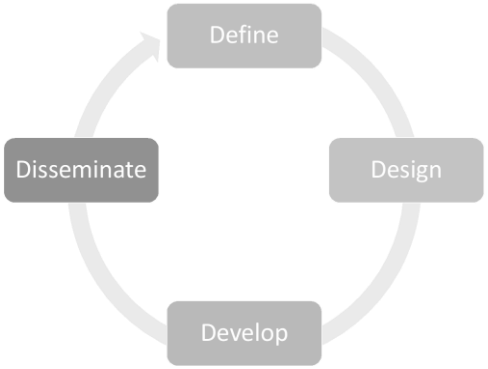

Figure 2. 4D Model [34][35]

The description in each of the 4D stages can be seen as follows:

1. Define

The purpose of this stage is to ascertain what will be developed along with the criteria. This stage has a need analysis, which is carried out systematically and structured.

2. Design

The purpose of this stage is to develop a general concept of the planned product according to its specifications.

3. Develop

This stage includes the activities of designing a product in detail, changing, or transforming a general design into a detailed design in accordance with predetermined product specifications and testing the design or product.

4. Disseminate

This stage includes the dissemination of products tested for stakeholder use.

Architecture Design Education performs product trial stages which include tests of the validity, practicality, and effectiveness of the product. Validity Test illustrates the ability of measuring instruments to measure what should be measured. The validity test illustrates the accuracy of a product developed or the product to be tested. A product can be said to be valid if it meets the criteria set.

[31] Robert Maribe Branch, *Instructional Design : The ADDIE Approach*, 1st edn (New York: Springer Science+Business Media, 2009) <https://doi.org/10.1007/978-0-387-09506-6>.

[32] Lawanto.

[33] Supratman, Arianto, and Maiyana.

[34] Lawanto.

[35] Supratman, Arianto, and Maiyana.

Ready-to-use quality products are products that have passed the validity test. In order to get good results, validation was performed using a questionnaire, where users of the system or application simply fill in the questionnaire. The product validity test results by the validators could conclude whether or not a product or application is valid. This validity test was carried out by several experts and/or users by spreading the validity questionnaire [36].

Validity test is carried out by referring to Aiken's V as follows:

$$V = \frac{\sum s}{n(c-1)}$$

Description:

s : r – lo

lo : The lowest validity value

c : The highest validity value

r : Value given by validator

n : Number of assessors

The validity value is between 0.00 and 1.00. The category of determining validity with Aiken's V states that a product is valid if it has a range of Aiken's V values from 0.60 - 1.00 and is invalid if the Aiken's value is smaller than 0.60. [37].

A product practicality test is used to see whether the product produced is practical to use or not. A practical product is one that is easy to understand and use. To measure the practicality of a system or application, the user (stakeholder) must ensure that the resulting system or application is understood easily and is not difficult to use.

The product practicality test was based on a questionnaire filled out by the practitioner and then analyzed. The results of the practicality analysis used the formula as stated by Riduwan (2013) [38] are as follows:

$$\mathrm{N} = \frac{\mathrm{BP}}{\mathrm{BM}} \times 100\%$$

Description:

N= Value obtained

BP= The weight given to the questionnaire

BM=Maximum weight for each question in the questionnaire

The sum of the values per indicator was measured by the following Likert scale criteria:

Table 1. Practicality Percentage [39]

Percentage (%)	Criteria
0-20	Not Practical
21-40	Less Practical
41-60	Fairly Practical
61-80	Practical
81-100	Very Practical

The effectiveness test was carried out to see the compatibility between the product results with the goals that have been set. According to Reigeluth, the effectiveness of a product developed is very important to be seen, because it will be able to show the implementation of theories and or models that are relevant to certain conditions.

According to Nieveen, the design of the model must be consistent between expectations and actual performance[40]. The expectation shows that the product is designed according to the needs of the outcomes.

Based on this, the researcher showed the effectiveness of the product by responding to the question of whether this system can be used. The Kappa moment formula used is as follows:[41].

[36] Efmi Maiyana and others, 'Application of Android System for Anti-Drug Information', *Journal of Physics: Conference Series*, 1471.1 (2020) <https://doi.org/10.1088/1742-6596/1471/1/012001>.

[37] Aiken Lewis R, 'Three Coefficients for Analysing Reliability and Validity of Rating.', *Educational and Psychological Measurement*, 45 (1985), 131–42 <https://doi.org/10.1177/07399863870092005>.

[38] Supratman Zakir and others, 'Development of 3D Animation Based Hydrocarbon Learning Media', *Journal of Physics: Conference Series*, 1779.1 (2021) <https://doi.org/10.1088/1742-6596/1779/1/012008>.

[39] (Riduwan, 2013)

[40] Branch.

[41] Randa Sagita, Fajriah Azra, and Minda Azhar, 'Pengembangan Modul Konsep Mol Berbasis Inkuiri Terstruktur Dengan Penekanan Pada Interkoneksi Tiga

$$k = \frac{\rho - \rho e}{1 - \rho e}$$

Description:

k = Kappa moment that shows product validity

ρ = Realized proportion, calculated by means of values given by the validator divided by the maximum value

- Creta user - User verification

ρe= Unrealized proportion, calculated by means of the maximum value minus the total number of validated values divided by the maximum value with the following conditions:

Table 2. Decision Categories Based on Kappa Moment (k)

Interval	Category
0.81 – 1.00	Very High
0.61 – 0.80	High
0.41 – 0.60	Fair
0.21 – 0.40	Low
0.01 – 0.20	Very Low
≤ 0.00	Invalid

Result and Discussion

Based on the research stages that have been described, the WBL system is developed as follows:

Define; is the system design stage which includes the identification of system components that will be designed in detail so as to provide a general description to the stakeholders or actors (people involved in system development) about the system to be developed.

To do system design general researchers used development system tools namely Use Case Diagram and Context Diagram. The Use Case Diagram illustrates the actors involved in the system along with the large activities (cases) that will take place in the system. The context diagram is used to show the flow in and out of the system and in and out of the entity.

a) WBL System Context Diagram

WBL System Context Diagram illustrates how data flows both incoming to and outgoing from the source. In this diagram, there is only one process, namely the process in the WBL system.

The WBL context diagram can be seen in the following Figure 3.

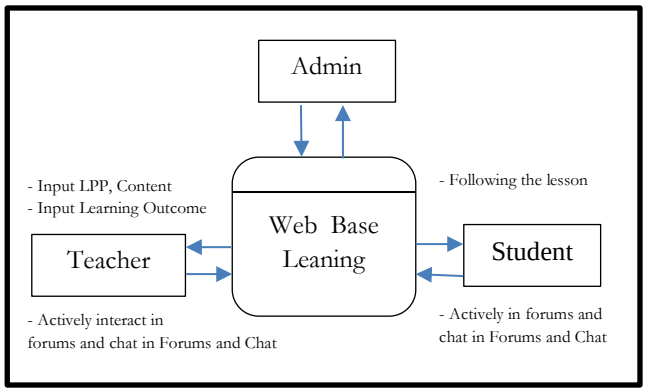

Figure 3. Context Diagram of System Developed

In the context diagram above, there are 3 (three) sources, namely admin, lecturer, and student. The three sources show both incoming data flow and outgoing data flow.

b) WBL Use Case Diagram

WBL design used the Use Case diagram as can be seen in Figure 4

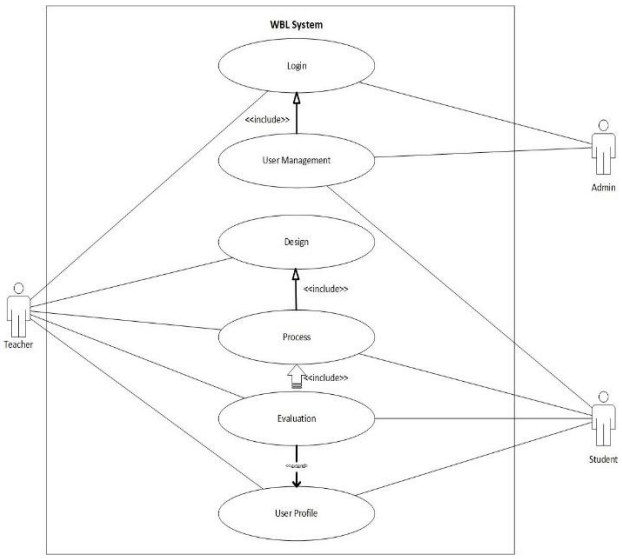

Figure 4. Use Case of WBL System

The WBL Use Case above shows that the WBL system was designed involving three actors,

Level Representasi Kimia Untuk Kelas X SMA', *Jurnal Eksakta Pendidikan (Jep)*, 1.2 (2017), 25–32 <https://doi.org/10.24036/jep.v1i2.48>.

namely admin, lecturer, and students. These three actors have their respective roles and there is also a shared activity or role in the system. As in the case of activity, the learning process and learning evaluation are cases that are shared by the lecturer and student actors.

1. **Design;** At this stage, there was a series of activities to design several components, namely input design, output design, database, output, technology design, and control design.

a. Input Design

Input design includes input designs for admin, lecturer, and students. Input design includes student data input, course input, learning plan input, lecturer data input, value input, exam question input. This input design can be adjusted to the needs. An example of input design is as follows.

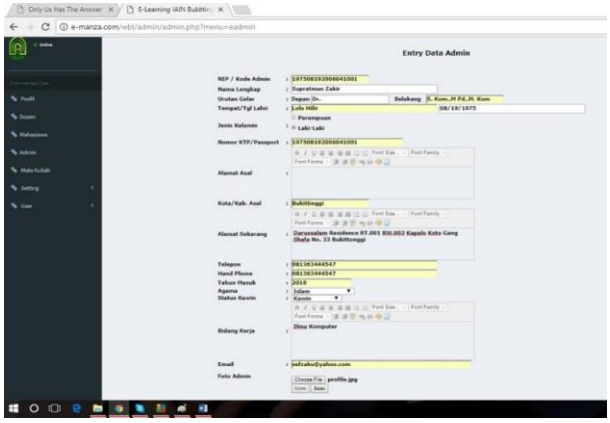

Figure 5. Input Design

b. Output Design

The output design includes course report, student attendance report, learning plan report, student grade report, and student activity report. An example of output design is as follows.

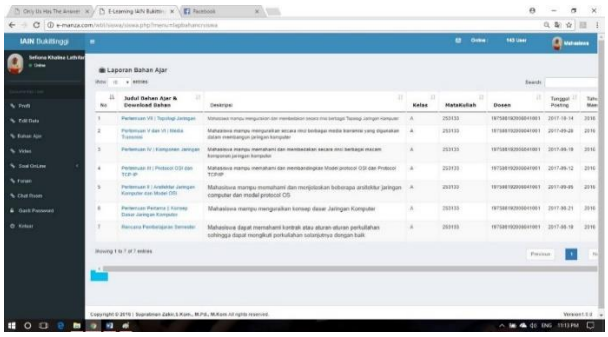

Figure 6. Output Design

c. Database Design

The database is an important aspect of an information system. The following are the databases needed for WBL development. Database design take the form of tables containing components of a file. The tables developed were student table, course table, lecturer table, score table, attendance table, activity table, and login table. An example of database design is as follows.

Table 3. Design File

No	Field	Size	Type
1	NIM	8	Varchar
2	Nama_Mahasiswa	40	Varchar
3	Program_Studi	40	Varchar
4	Fakultas	20	Varchar
5	No_Hanphone	15	varchar

d. Technology Design

For the WBL system to run optimally, it is necessary to have a technology support system for the WBL system. Some things to consider in this issue are:

1) Server Technology

For WBL to be accessed properly by the client or user, it is very important to have a reliable server. The sustainability of server services is very important because the WBL system does not recognize the limitations of time and space. In this study, researchers entrusted the server to companies that have a good reputation in providing online-based services.

2) Network Technology

Accessing WBL requires a stable internet network. On average, a web can be accessed with a minimum bandwidth of 2 Kbps. This study used a bandwidth of 265 Mbps with Full Fiber Optic support. This shows that if added by the number of users, i.e., the academic community at the study site, then this involves 10.24 Kbps per user. Thus, the condition of the study site was very decent above the minimum connection average.

e. Control Design

To maintain stability, the security of the WBL system also needs to be considered. Some important things to consider are:

i. Server security: an adequate security system is prepared by the hosting service provider company
ii. The WBL system is equipped with unauthorized user protection by using the system login.

2. Develop; there are three activities in the develop stage, namely coding, testing and revision.

a. Coding, is an activity of translating designs into programming languages, in this context, PHP which translates designs into applications that are understood by computers so as to produce a system as desired by the user.

Testing; there are activities related to the results of coding that have been performed, whether in accordance to expectations or not. There are several indicators that can be used as a reference in this test, namely, that a program is free from Language Error, Run Time Error, and Logical Error. Language error is also called error. Syntax Error is an error in writing the source program that is not in accordance with what has been required. Run Time Error is an error that occurs when the program is run that causes the program process to stop. Logical Error is an error from the developed program logic. This error is difficult to find because the program results are still generated but not in accordance with what is intended. In this stage, testing was conducted by using the Black Box Testing system, which is a system testing method that uses system modules that have been designed. If the modules run according to the system design, the system can be said to be in accordance with the design.

Based on the testing results, the application runs as desired, and only needs a few revisions on the user interface are needed.

b. Revision; Improve the system based on the results of the testing system. Improvement of the user interface was performed so that users can easily use this application

4. **Disseminate;** There are two activities namely product distribution and maintenance. At this stage, the system has been implemented and if there is a disturbance in the system, a complete system review is performed. The review includes the supporting infrastructure of the system, database, programming or coding, and system security.

After the WBL architecture was developed, a product validity test was performed. The product validity test obtained a "v" value of 0.78, this shows that the product was in the valid category in developing and implementing WBL, and is capable of dealing with the challenges of the Covid-19 pandemic. The practicality test value was 0.87 which means that the WBL architecture design was practical. The value of the effectiveness test was 0.86 which means the WBL architecture design was effective and can be used as a guide in developing WBL.

Based on the test results of the WBL architecture above, it can be interpreted that the WBL architecture can be used as a reference in developing learning, so that teachers can create learning programs that follow technological developments, increase the joy of learning, and can be carried out at anytime anywhere.

Conclusion

The WBL architecture design is used as a guide to design and implement WBL by using a pure programming language. With this architectural design, WBL development can be performed more systematically, sequentially, and measurably so that WBL development is undertaken more easily. This WBL architecture design is not a guide that must be followed step by step but is only limited to the logical design of how a WBL system is formed. Users can elaborate on the WBL architecture design that is in accordance with the needs and logic of the development system used and is adjusted to the characteristics, environment, resources, and needs

of the relevant institutions. This WBL architectural design is one solution that can be used in the learning movement, both formal learning and digital informal learning, considering the huge contribution of digital learning to improve one's academic performance[42]. Anyone who has digital competence is also responsible for what is done in the digital world[43]. Likewise, a student's digital competence to participate in digital informal learning will affect his academic achievement[44].

References

Journals

Alkouz, a.M., 'Web Services Based Learning Objects Generator for Device-Independent M-Learning', *International Journal of Emerging Technologies in Learning*, 2006, 1–3

Azizi, Baharak, 'Learning Management System Software (LMS) ABSTRACT ':, *International Journal of Advanced Biotechnology and Research (IJBR)*, 7.4 (2016), 2110–19

Bartlett, Michelle E, and James E Bartlett, 'Case Study on the Impact of Technology on Incivility in Higher Education', *The Journal of Educators Online*, 13.2 (2016), 1–18

Branch, Robert Maribe, *Instructional Design : The ADDIE Approach*, 1st edn (New York: Springer Science+Business Media, 2009) <https://doi.org/10.1007/978-0-387-09506-6>

Bygstad, Bendik, Egil Øvrelid, Sten Ludvigsen, and Morten Dæhlen, 'From Dual Digitalization to Digital Learning Space: Exploring the Digital Transformation of Higher Education', *Computers and Education*, 182.August 2021 (2022) <https://doi.org/10.1016/j.compedu.2022.104463>

Calvani, Antonio, Antonio Fini, and Maria Ranieri, 'Assessing Digital Competence in Secondary Education. Issues, Models and Instruments', *Issues in Information and Media Literacy: Education, Practice and Pedagogy*, 2 (2009), 153–72

Czerkawski, Betül C, 'Blending Formal and Informal Learning Networks for Online Learning', *International Review of Research in Open and Distributed Learning*, 17.3 (2016) <https://doi.org/https://doi.org/10.19173/irrodl.v17i3.2344CopiedAn error has occurred>

Degner, Miriam, Stephanie Moser, and Doris Lewalter, 'Digital Media in Institutional Informal Learning Places: A Systematic Literature Review', *Computers and Education Open*, 3 (2022), 100068 <https://doi.org/10.1016/j.caeo.2021.100068>

Ferrari, Anusca, Yves Punie, and Barbara N Bre, *DIGCOMP : A Framework for Developing and Understanding Digital Competence in Europe* ., 2013 <https://doi.org/10.2788/52966>

Hariadi, Bambang, 'Web-Based Cooperative Learning, Learning Styles, and Student'S Learning Outcomes', *Jurnal Cakrawala Pendidikan*, 53.2 (2015), 160–70 <https://doi.org/10.1017/CBO9781107415324.004>

Hutain, Jérôme, and Nicolas Michinov, 'Improving Student Engagement during In-Person Classes by Using Functionalities of a Digital Learning Environment', *Computers and Education*, 183.August 2021 (2022) <https://doi.org/10.1016/j.compedu.2022.104496>

Jeon, Jaehee, and Sisook Kim, 'The Mediating Effects of Digital Literacy and Self-Efficacy

[42] Mehrvarz and others.

[43] Miriam Degner, Stephanie Moser, and Doris Lewalter, 'Digital Media in Institutional Informal Learning Places: A Systematic Literature Review', *Computers and Education Open*, 3 (2022), 100068 <https://doi.org/10.1016/j.caeo.2021.100068>.

[44] Anusca Ferrari, Yves Punie, and Barbara N Bre, *DIGCOMP : A Framework for Developing and Understanding Digital Competence in Europe* ., 2013 <https://doi.org/10.2788/52966>.

on the Relationship between Learning Attitudes and Ehealth Literacy in Nursing Students: A Cross-Sectional Study', *Nurse Education Today*, 113.April (2022), 105378 <https://doi.org/10.1016/j.nedt.2022.105378>

Kuklina, Ludmila, and Sergey Kuklin, 'Web Content as a Base Component of the Educational Environment', in *SHS Web of Conferences* (Moscow, Russia: EDP Sciences, 2016), 02023, 0–3 <https://doi.org/10.1051/shsconf/20162902023>

Lawanto, Oenardi, 'Pembelajaran Berbasis Web Sebagai Metoda Komplemen Kegiatan Pendidikan Dan Pelatihan*', *Unitas*, 9.1 (2000), 44–58

Lee, Jung-Sook, 'The Relationship Between Student Engagement and Academic Performance: Is It a Myth or Reality?', *The Journal of Educational Research*, 107.3 (2014), 177–85 <https://doi.org/10.1080/00220671.2013.807491>

Maiyana, Efmi, Mira Susanti, Supratman, Yuninda Tria, and Ramdalel, 'Application of Android System for Anti-Drug Information', *Journal of Physics: Conference Series*, 1471.1 (2020) <https://doi.org/10.1088/1742-6596/1471/1/012001>

Mehrvarz, Mahboobe, Elham Heidari, Mohammadreza Farrokhnia, and Omid Noroozi, 'The Mediating Role of Digital Informal Learning in the Relationship between Students' Digital Competency and Their Academic Performance', *Computers and Education*, 167.June 2020 (2021), 104184 <https://doi.org/10.1016/j.compedu.2021.104184>

Meyers, Eric M., Ingrid Erickson, and Ruth V. Small, 'Digital Literacy and Informal Learning Environments: An Introduction', *Learning, Media and Technology*, 38.4 (2013), 355–67 <https://doi.org/10.1080/17439884.2013.783597>

Moldavan, Alesia Mickle, Christine Edwards-Leis, and Jennifer Murray, 'Design and Pedagogical Implications of a Digital Learning Platform to Promote Well-Being in Teacher Education', *Teaching and Teacher Education*, 115 (2022), 103732 <https://doi.org/10.1016/j.tate.2022.103732>

Ng, Wan, 'Can We Teach Digital Natives Digital Literacy?', *Computers and Education*, 59.3 (2012), 1065–78 <https://doi.org/10.1016/j.compedu.2012.04.016>

Persada, Alif Ringga, 'Peningkatan Hasil Belajar Matematika Melalui Pengembangan Bahan Ajar Berbasis Website', *EduMa*, 6.1 (2017), 62–76 <https://doi.org/10.24235/eduma.v6i1.1661>

R, Aiken Lewis, 'Three Coefficients for Analysing Reliability and Validity of Rating.', *Educational and Psychological Measurement*, 45 (1985), 131–42 <https://doi.org/10.1177/0739986387009 2005>

RIDUWAN, *BELAJAR MUDAH PENELITIAN UNTUK GURU-KARYAWAN DAN PENELITI PEMULA*, ed. by H.J.S. HUSDARTA, ADKON, NONO MULYONO, and SUBANDI, 9th edn (BANDUNG: ALFABETA, 2013)

Rifai, Irfan, 'Designing Content For A Web-Based Application Used In Blended Composition Classes: Things To Consider In The EFL/ESL Context', *Humaniora*, 5.2 (2014), 1049–55

Sackey, Donnie Johnson, Minh-Tam Nguyen, and Jeffery T Grabill, 'Constructing Learning Spaces: What We Can Learn from Studies of Informal Learning Online', *Computers and Composition*, 35 (2015), 112–24

<https://doi.org/https://doi.org/10.1016/j.compcom.2015.01.004>

Sagita, Randa, Fajriah Azra, and Minda Azhar, 'Pengembangan Modul Konsep Mol Berbasis Inkuiri Terstruktur Dengan Penekanan Pada Interkoneksi Tiga Level Representasi Kimia Untuk Kelas X SMA', *Jurnal Eksakta Pendidikan (Jep)*, 1.2 (2017), 25–32 <https://doi.org/10.24036/jep.v1i2.48>

Shen, Demei, Moon Heum Cho, Chia Lin Tsai, and Rose Marra, 'Unpacking Online Learning Experiences: Online Learning Self-Efficacy and Learning Satisfaction', *Internet and Higher Education*, 19 (2013), 10–17 <https://doi.org/10.1016/j.iheduc.2013.04.001>

Supratman, Toni Arianto, and Efmi Maiyana, 'Development of Local Web-Based Learning (LWBL) as Low-Cost Digital Learning Efforts', *Journal of Physics: Conference Series*, 1471.1 (2020) <https://doi.org/10.1088/1742-6596/1471/1/012003>

Ülker, Doğancan, and Yücel Yılma, 'Learning Management Systems and Comparison of Open Source Learning Management Systems and Proprietary Learning Management Systems', *JOURNAL OF SYSTEMS INTEGRATION*, 2 (2016), 18–24 <https://doi.org/10.20470/jsi.v7i2.255>

Wihastyanang, Wardani Dwi, Daning Hentasmaka, and Rosi Anjarwati, 'Active Learning Using Learning Management System To Improve Students ' Competence', *Journal on English as a Foreign Language*, 4.1 (2014), 1–4

Zakir, Supratman, 'Modernisasi Administrasi Usaha Kecil Menengah (Ukm) Melalui Pemanfaatan Sistem Informasi', *Proseding Seminar Nasional Asosiasi Perguruan Tinggi Ilmu Komputer (APTIKOM)*, 1.1 (2016) <https://doi.org/10.5281/zenodo.241507>

Zakir, Supratman, Sarjon Defit, and Vitriani, 'Indeks Kesiapan Perguruan Tinggi Dalam Mengimplementasikan Smart Campus', *Jurnal Teknologi Informasi Dan Ilmu Komputer (JTIIK)*, 6.3 (2019), 267–76 <https://doi.org/10.25126/jtiik.20196986>

Zakir, Supratman, Efmi Maiyana, Agus Nur Khomarudin, Rina Novita, and Mayuti Deurama, 'Development of 3D Animation Based Hydrocarbon Learning Media', *Journal of Physics: Conference Series*, 1779.1 (2021) <https://doi.org/10.1088/1742-6596/1779/1/012008>

Zakir, Supratman, and Hidayat Rahmat, 'Web-Based Learning Model That Can Be Implemented in Learning Settings Without Being Limited by Time , Place and Space', *Journal of Theoretical an Applied Information Technology*, 96.23 (2018), 7996–8005