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THE ROLE OF SELF-ORGANIZED LEARNING ENVIRONMENT (SOLE) BASED E-LEARNING ON PROGRAMMING LOGIC LECTURES OF UNDERGRADUATE STUDENTS OF EDUCATIONAL TECHNOLOGY OF UNDIKSHA

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Abstract: The lack of optimal student learning outcomes over last 3 years is the main problem in programming logic courses. Based on this, the aim of this research is to develop Self-Organized Learning Environment (SOLE) based e-learning so that problems can be solved. This research is development research that focuses on producing and measuring the quality of this e-learning in the programming logic course in Educational Technology Study Program, FIP Undiksha. This research is guided by the ADDIE model which includes: 1) Analysis stage which consists of material and evaluation analysis, 2) Design stage which includes activities for selecting & designing materials and learning models presented in e-learning, 3) Development Stage which is the assembly stage of components that have been prepared at the design stage, 4) implementation phase is carried out through a limited trial phase, and 5) Evaluation stage to determine the quality of the product. From the validation tests, the results showed that the e-learning was declared valid with very good quality in content aspect with a score of 95.4%, design aspect with a score of 91.7% and the technology and media aspect with a score of 94.2857%. Based on individual and small group response tests, this e-learning declared very good quality with scores of 92.12% and 93.13% respectively. From these findings it can be concluded that e-learning based on SOLE model is valid and suitable for use in learning programming logic to solve the problems.

Keywords: E-learning; Self Organized Learning Environment; Programming Logic

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INTRODUCTION

The Programming Logic course is one field offered by the IPPB Department of Educational Technology Study Program Faculty of Science Education. Referring to the description of the programming logic course itself, this course aims to provide students with insight and skills in using a series of logic in programming computer applications through what are called algorithms so that the applications produced to solve problems in learning can run effectively. The material offered in the programming logic course includes: 1) Algorithm concepts in programming, 2) Concepts and Various Data Types, 3) The concept and use of loop logic structures to solve programming problems 4) The concept and use of selection logic structures to solve programming problems, 5) arrays and their uses, 6) The concept of file operations and how to use them, 7) Product

development models, 8) Implementation of programming logic in software development projects through case studies in educational environments (Sukmana & Simamora, 2022). Programming logic is very important to learn so that students have good abilities in computational thinking. in connection with this, Hsu et. al. (2018) argue that programming is the most appropriate way to train computational thinking skills (Gupta & Tiwari, 2022). Computational thinking is interpreted as the thought process involved in formulating a problem and solving it in such a way so that the computer can carry it out effectively (Papert dalam Bull et al., 2020). Therefore, through this course, it is hoped that Educational Technology graduate able to become a competent educational technologist, especially in terms of developing IT-based learning resources.

Based on data collection on student learning outcomes in the programming logic course, it shows that student learning outcomes in this course are still less satisfactory thus resulting in a lack of skills. The learning outcomes in the programming logic course within three years are presented as in table 1 below.

Table 1: Middle Semester Scores for Programming Logic Courses for Educational Technology Study Program Students in the Last 3 Years

No	Year	Middle Semester Scores
1	2019	59
2	2020	68,1
3	2021	71,27

From the data presented in table 1, it can be seen that the average Mid-Semester Exam score is still considered unsatisfactory (score < 75). this score Basically is a representation of students' less than optimal abilities in programming logic courses. Based on the observations, the lack of optimal knowledge in this course is caused by various factors, including 1) The students' educational background is heterogeneous so that their understanding of programming logic is very diverse; 2) The impact of the Covid-19 pandemic has had implications for students' learning patterns and willingness; 3) lack of awareness and willingness in terms of literacy activities; 4) Less optimal use of learning resources; 5) lack of student activity in the learning process, especially in exploring knowledge to improve their understanding of programming logic.

Based on this phenomenon, the solution to solve the problems that occur is to develop e-learning based on the Self-Organized Learning Environment (SOLE) learning model. This solution is a learning strategy that aims to make it easier for students to explore and understand their knowledge in a broad, dynamic manner but while still adhering to systematic learning principles. E-learning is a learning media which involves the use of computer and internet technology which is open distance learning (ODL). Open distance learning is a distance learning model, where lecturers and students are not in the same place and at the same time, and do not physically meet face to face (Sucipto, 2017). Based on research conducted by Sukmana and Sudarma related to e-learning in learning, it shows that e-learning has proven effective in improving student learning outcomes and can improve students' creative thinking abilities (Sukmana & Sudarma, 2021).

Besides that, By combining e-learning with the Self-Organized Learning Environment (SOLE) model, the existence of e-learning becomes relevant for solving

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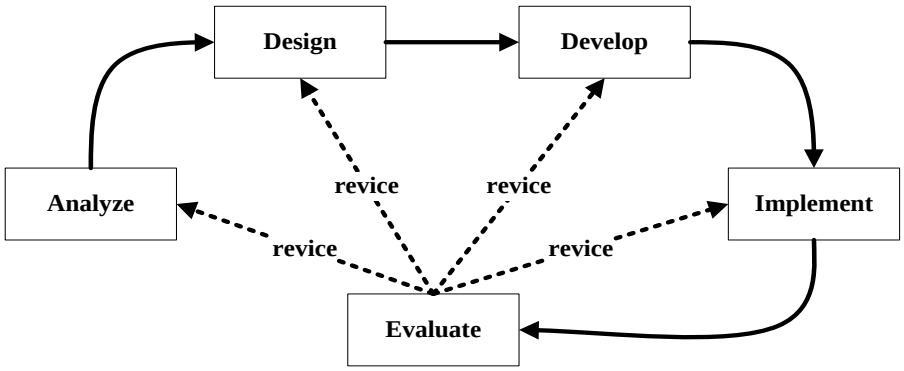
learning problems currently faced by students, especially due to the shift in their main learning habits during the emergence of the Covid-19 pandemic. The Self-Organized Learning Environment (SOLE) model is a contextual learning model through complex activities where students cannot learn properly face to face can actively explore knowledge. With the Self Organized Environment learning (SOLE) model as basic learning patterns in e-learning then students can control their own learning and have opportunity to explore knowledge freely and as widely as possible through learning resources on the internet so that they can build meaningful knowledge (Anis & Anwar, 2020). In addition, the use of Self-Organized Environment learning (SOLE) provides opportunities for students to build important attitudes for successful lifelong learning (Cobb, 2010 dalam Baylor, 2020).

METHOD

This research is development research which refers to the ADDIE development model which, as the name suggests, consists of 5 stages, namely (1) Analysis, (2) Design, (3) Development, (3) Implementation, (5) Evaluation (Gagne et al., 2005)



Gambar 2: ADDIE Model Stage
(Sumber: Gagne et al., 2005)

Based on Figure 2, each stage in the ADDIE product development model is basically connected to each other. The non-dashed line shows that the process flows from the analysis stage to the evaluation stage, while the dotted line shows the feedback path in improving the design based on the evaluation carried out (Gagne et al., 2005)

The test subjects in this research were 3 experts consisting of content experts, learning design experts, learning media experts, 3 students as individual test subjects, 9 students as small group subjects. The data collected in this research is quantitative data and qualitative data. Research data was analyzed using qualitative descriptive analysis and quantitative descriptive analysis. The formula used to calculate the percentage for each subject is as follows.

The data collected in this research is quantitative data and qualitative data. Research data was analyzed using qualitative descriptive analysis and quantitative descriptive analysis. The formula used to calculate the percentage for each subject is as follows.

$$\text{Persentase} = \frac{\sum(\text{Answer} \times \text{weight of each choice})}{\text{n} \times \text{Highest Weight}} \times 100\%$$

Description:
∑ = amount
n = the total number of questionnaire items

To calculate the overall percentage of subjects, the formula is used:Prosentase = $\frac{F}{n}$

Description:
F = the total percentage of subjects
n = number of subjects

To be able to give meaning and decision-making, the following provisions are used.

Tabel 2: Attainment Rate Conversion in Development Product Trials with Scale 5

Achievement Level	Qualification	Information
90% - 100%	Very good	No need to revise
75% - 89%	Good	Slightly revise
65% - 74%	Pretty good	Revise sufficiently
55% - 64%	Not good	Many things have been revised
0 - 54%	Very Not Good	re-make the product

(source: Tegeh & Kirna, 2010)

RESULT AND DISCUSSION

The development of e-learning based on the Self Organizing Learning Environment (SOLE) model in programming logic courses was successfully developed through the ADDIE model. The analysis stage is used to collect data through (1) material analysis, (2) analysis of student characteristics, (3) analysis of learning resources. The design stage focuses on designing learning activities in e-learning. The Self Organizing Learning Environment (SOLE) model which is integrated into e-learning is presented in table 3 below.

Table 3: Self Organizing Learning Environment (SOLE) Design

Phase	Activity
questioning	1. Determine the group. 2. Explain the learning rules 3. Ask inquiry questions. Stimulus is generated through discussion topics related to the material to be discussed.
Investigate	1. Provide opportunities for students to work in groups for a predetermined time by utilizing the resources that have been

	prepared in the LMS as well as other online sources to find answers to the questions that have been asked. 2. The lecturer does not intervene but gives authority to the group leader to coordinate and lead problem-solving discussions. 3. Record the results of discussions and study group findings and ask reflection questions related to the problem solving process and findings.
Review	4. Each group presents the results of their work and other participants provide feedback (answers/information) regarding the work that has been done and presented. 5. Lecturers facilitate discussions and provide suggestions regarding the work that has been developed

The above design is then translated into learning activities in the LMS in the Programming Logic Course. This e-learning can be accessed at the link: https://elearning.undiksha.ac.id/course/view.php?id=6742

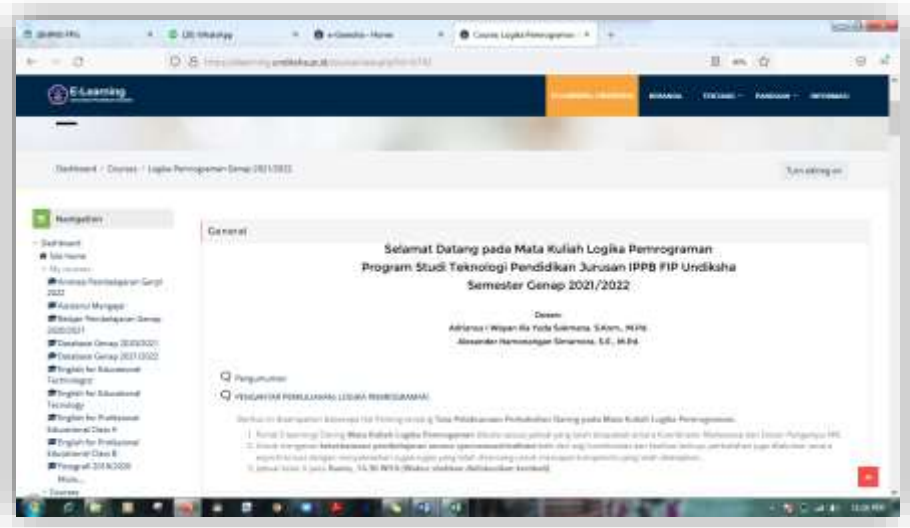


Figure 4: Self-Organizing Learning Environment (SOLE) Based E-Learning LMS Page

Validity of E-Learning Based on SOLE Model

1) Design Aspect

Table 4: Learning Design Validation Test

No	Aspect/Statement	score
CURRICULUM ASPECTS		
1	Clarity of course identity	5
2	Conformity of learning objectives with learning achievement indicators	4

ASPECTS OF LEARNING METHODS		
3	Clarity of learning design	5
4	Clarity of learning instructions	4
5	Suitability of the sequence of learning activities with the model used	4
6	Availability of access to self-paced learning	5
7	Providing learning resources that students can learn	5
8	Adequate support for learning materials (performance support materials) in the e-learning learning model	4
9	Accommodation of discussion activities between educators and students	5
10	Adequate time management	5
EVALUATION ASPECTS		
11	Availability of learning assessments	4
12	Clarity of instructions for completing assignments/tests	5
Total Score		**55**
Value		**91.7**

Based on validation of design aspects by Learning Design Experts, it was found that e-learning based on the SOLE model qualified as **Very Good** in terms of learning design. This means that based on learning design aspects, SOLE-based e-learning is **valid and suitable** for use in the learning process.

2) Media Aspect

Table 5: Media Aspect Validation Test

No	Aspect/Statement	score
A	**APPEARANCE**	
1	E-leaning layout settings are simple and appropriate to the content	5
2	Attractive display colors	5
3	The layout of the images corresponds to the effectiveness of conveying the message	4
4	The quality of the presentation of illustrations (images, videos) in electronic content (text, video, etc.)	5
5	The relationship between illustrations and material	5
6	Appropriate text size selection	4
7	The level of text readability is clear	5
8	Attractive colors and text formatting	5
B	**INTERACTIVITY**	
9	Easy of access to e-learning sites	5
10	Easy of use of e-learning media	5

11	navigation functionality in e-learning	5
C	**BENEFITS**	
12	The use of e-learning makes the learning process easier	5
13	*E-learning can increase students' interest in learning*	4
14	*E-learning can motivate students to learn*	4
Total Score		**66**
Value		**94.2857**

Based on a review of media quality aspects by Media Experts, it is known that SOLE-based e-learning has very good qualifications in terms of media quality. So from the aspect of media quality, e-learning based on SOLE learning is valid and suitable for use in the learning process.

3) Content aspect

Table 6: Table 6: Content Aspect Validation Test

No	Aspect/Statement	score
CURRICULUM ASPECTS		
1	Suitability of material to learning objectives	5
2	The suitability of the material is in accordance with the expected competencies	5
MATERIAL ASPECTS		
3	Presentation of material is free from conceptual errors	5
4	The accuracy of the type of media with the learning material	5
5	Students can study material at their learning pace	4
6	Online learning can help complete material that has a wide scope	4
7	The material presented in E-learning is easy to understand	4
LANGUAGE ASPECTS		
8	Study instructions can be understood well	5
9	The use of language does not give rise to multiple interpretations	5
10	The language used uses good and correct Indonesian rules	5
EVALUATION ASPECTS		
11	Relevance of questions to learning objectives	5
12	Clarity of assessment of learning outcomes	5
Total Score		**57**
Value		**95**

Based on the assessment carried out by content experts, it is known that SOLE learning-based e-learning has **Very Good** qualifications in terms of learning content.

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This means that e-learning based on SOLE learning is **valid and suitable** for use in the learning process.

Student Response to E-Learning Based on the SOLE Model

1) Individual Test Results

Table 7: Individual Testing

No	Aspect/Statement	R1	R2	R3
1	I can enter or exit e-learning easily	5	5	5
2	Learning materials and activities can be accessed freely and easily	5	5	5
3	Relevant teaching materials are available for learning materials	5	5	4
4	With the online learning system, students can complete the existing material	5	4	5
5	The learning flow in E-learning is clear so that it can support independent learning	4	4	4
6	The appearance of the e-learning page is simple and attractive	4	4	4
7	The material is presented in communicative language	5	4	5
8	The language used is easy to understand	4	5	5
9	e-learning provides exercises or assignments to strengthen understanding of the material	5	5	5
10	Suitability of evaluation with learning objectives	5	5	5
11	E-learning supports learning motivation	4	4	4
Score		**51**	**50**	**51**
Value Per Respondent		**92.73**	**90.91**	**92.73**
Mean Respondent Value		**92.12**		

Based on tests carried out on 3 subjects of individual testing, the results obtained show that e-learning based on SOLE model has **very good** qualifications, so it can be said that e-learning based on SOLE model is practically used in the learning process.

2) Small Group Testing

Table 8: Small Group Test Results

No	Small Group Test Respondents	Skor	Nilai
1	Small Group Respondents 1	50	90.91
2	Small Group Respondents 2	52	94.55
3	Small Group Respondents 3	51	92.73
4	Small Group Respondents 4	51	92.73
5	Small Group Respondents 5	52	94.55

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6	Small Group Respondents 6	52	94.55
7	Small Group Respondents 7	52	94.55
8	Small Group Respondents 8	50	90.91
9	Small Group Respondents 9	51	92.73
Average			**93.13**

Based on tests carried out by 9 subjects of small group test, the results obtained show that the e-learning has **Very Good** qualifications so it can be said to be **practically used** in the learning process.

Based on a series of tests that have been carried out, the results show that "Self Organized Leaning Environment (SOLE) based e-learning is valid and suitable for use to support Programming Logic lectures in the Educational Technology Study Program, IPPB Department, Faculty of Education, Undiksha". This achievement is of course inseparable from the aspects that must be considered in learning products, namely content aspects, learning design and media aspects.

As mentioned above, one of the determining factors in the quality of e-learning is the content. E-learning based on Self Organized Leaning Environment (SOLE) has good content or material and is mapped according to the learning curriculum which is reflected in Basic Competencies, Indicators and learning objectives. Mapping and organizing learning content is very important as an effort to determine and grouping learning material into subject matter, sub-subject matter, so that it is in accordance with predetermined learning outcomes (Chaeruman, 2018). Apart from that, the Self Organized Leaning Environment (SOLE) learning model requires a variety of content so that students can freely explore their knowledge. Content packaging into various formats as well as learning motivation through developed e-leaning.

This e-leaning content is presented in digital text, image and video formats. In this regard, e-content is a learning package consisting of readings, assignments, discussion forums and multimedia links for demonstrations, simulations, elaborative explanations, case studies, all of which have the potential to support learning (Kumar et al., 2021). Furthermore, Kumar et al. (2021) stated that the more interaction students have with content designed to involve students in an online learning environment, it is very possible for students to be more optimal in building their knowledge. Jonassen, Davidson, Collins, Campbell, & Haag, (1995) explained that the interaction between content and learners occurs after listening to demonstrations on certain topics, then they read, try assigned tasks and participate in online discussions as a form of disclosure, reflection and exchange processes. understanding (Kumar et al., 2021). This is in line with Asmawati's findings in her research which shows that online learning using the Self Organized Learning Environment (SOLE) learning model plays a role in developing students' literacy skills (Asmawati et al., 2021).

Another important element that determines the quality of e-learning based on Self Organized Learning Environment (SOLE) model is the learning design aspect which has embedded in it. Clarity of learning design and clear learning instructions really help students carry out learning systematically. E-learning is based on the Self Organized Learning Environment (SOLE) model, facilitating students with learning scenarios that

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accommodate student independence and freedom in carrying out their learning both synchronously and asynchronously. Apart from that, the adaptation of the Self Organized Learning Environment (SOLE) learning model as a pedagogical element in e-learning plays an important role in controlling the regularity of the student learning process that takes place through e-learning.

Regarding computational abilities in programming logic courses, Gupta & Tiwari (2022) explain that a good strategy for developing these abilities is to train students to detect programming problems in a social community and give them the opportunity to solve these problems collaboratively. For this reason, the Self Organized Learning Environment (SOLE) is a learning scenario that is very relevant to support this strategy which focuses on supporting students in learning through questions, collaboration and a well-framed inquiry process (Baylor, 2020). Technically, the steps for implementing the SOLE learning model consist of (Lenovo, 2022; Suciati, 2021): 1) Questions; 2) Investigate or Investigation; 3) Review or Observation.

Mitra & Crawley (2014) explain that the SOLE learning model is a virtual or online learning setting which focuses on the independent learning process by utilizing the internet which aims to develop students' competencies through: (1) creative thinking skills, (2) problem solving abilities, (3) communication skills (Lenovo, 2022; Mitra & Crawley, 2014). This model provides opportunities for students to organize themselves in groups and learn using computers connected to the internet with minimal support from educators (Dolan et al., 2013) so that students can control their learning process freely to build meaningful understanding (Anis & Anwar, 2020).

As previously explained, discussion forums and learning communities are important elements in the Self Organized Learning Environment (SOLE) scenario. Discussion forums provide space for students as a learning community to share information, insights and collaborate independently in solving problems in their learning topics. Hackman (1986) explained that the learning community in SOLE has its own authority to determine the structure, process, evaluation and correction when carrying out tasks (Sjølie et al., 2022).

CONCLUSION

From product validation carried out in terms of content, learning design and media quality, e-learning is based on Self Organized Leaning Environment (SOLE) model declared valid and suitable to applicate for learning process. Likewise, in individual and small group student response tests, e-learning based on the Self Organized Leaning Environment (SOLE) model is classified as very good and suitable for implementation in logic programming courses. There are 2 important aspects in e-learning based on the Self Organized Leaning Environment (SOLE) model so that it has the potential to be able to solve learning problems in the Programming Logic Course, namely the material/content aspect and the learning design aspect. Content which is appropriate to learning outcomes and presented through various digital formats gives students the opportunity to explore widely. Likewise in the learning design aspect, with the Self Organized Leaning Environment model as a guide in carrying out learning, students have the opportunity to develop creative thinking skills, communication skills, problem solving abilities to solve problems in learning programming logic.

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