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DEVELOPMENT OF PHYSICS E-LEARNING BASED ON PROBLEM BASED LEARNING TO IMPROVE STUDENTS' HIGH-LEVEL THINKING ABILITIES AND LEARNING INTERESTS IN FLUID MATERIALS

Yoli Wilanda Fitri[1], Fakhruddin[2], M.Rahmad[3]
[1,2,3]Magister of Physics Education, Faculty of Teaching Education, Universitas Riau, Pekanbaru, Indonesia

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ABSTRACT

One of method increase ability think level tall that is with application of suitable learning media For competence 21st century one of them is e-learning. One of the reasons for the low level of HOTS is the limited use of innovative media by teachers. E-learning in research This developed with the Problem Based Learning model which consists of above five syntax with objective capable increase HOTS skills and interests Study students. Problem Based Learning focuses on solving real-world problems as a trigger for learning. Based on results analysis needs carried out by researchers obtained that 91.5% of students interested For learning with using e-learning. Research This aiming For describe development e-learning physics based on problem based learning, acquiring e-learning physics that is feasible and practical For used in learning physics. Physics e-learning validated by 3 validators using sheet evaluation validity, as well as tested practicality by 3 teachers and 20 participants educate use sheet evaluation practicality. Research results show that e-learning physics based on problem based learning declared very worthy by the validator with mark validation 3.49 for material, 3.51 for media and 3.52 for pedagogy. Besides That based on practicality test results obtained the average value of teacher practicality is 88.00 (very practical) and the average practicality is 88.00 (very practical). Student 89.50 (very practical).

Corresponding Author:
Yoli Wilanda Fitri
Department Magister of Physics Education, Faculty of Teaching Education, Universiti Riau, Pekanbaru, Indonesia
Email: yoli.wilanda6901@grad.unri.ac.id

1. INTRODUCTION

Learning the 21st century is a learning process that directs participant educate for own skills think level high. Skills think level tall is a process that delivers participant educate at cognitive level highest, where participant educate Already capable think critical, creative, logical and systematic, with skilled analyze, evaluate until to create back. Concept think that's what is known with term skills think level tall or high order thinking skills (Robiah, 2018). Skills think level tall or HOTS is very much needed so that every participant educate capable compete face various challenge from the outside world. According to (Budiarta et al., 2018) ability think level tall can interpreted as thinking process ability complex that includes to unravel material, criticize as well as create solution to the problem solving problem. Anderson & Krathwohl in (Masitoh &

Aedi, 2020) explain that indicator for measure ability level tall in Bloom's taxonomy includes analyze (C4), evaluate (C5), create (C6).

System in Indonesia in the era of globalization often found problem lack of quality education (Tintingon et al., 2023). Improvement quality in Indonesia is hampered Because low quality education in Indonesia (Elvira, 2024). Based on PISA 2022 survey results obtained results that Indonesia's score is still is in the category low, where Indonesia is ranked eleven from lower with score mathematics 366, science 383, and reading 359, where score This experience decline compared to with results of the survey conducted previously namely in 2018. The decline the results of the survey by 13 points For Mathematics and Science, 12 points for read (Golla & Reyes, 2022). Causes low quality education in Indonesia because the amount institution education in Indonesia is constrained in matter supporting facilities learning, quality power educators, and a lack of curriculum in accordance in needs of the times (Elvira, 2024).

Facility lack of education complete even No there is, like laboratory along with lab equipment, library, and tools help modern learning, becoming barriers to effective learning processes (Pattimura et al., 2024). Inhibitors other is quality teachers who have not evenly become challenge alone, thing This can seen from many teachers who have not own adequate competence and training For teach in accordance with standard globalization in fulfil development of the times. Seen from factor affecting low quality education so the quality of education in Indonesia become urgent matter because become inhibitor provision source Power man quality that has the necessary skills and expertise for development nations in various field in today 's developments (Fajri, 2017). Quality education depends on quality learning with creative and innovative teachers in do lesson for example implementing interesting media for used student in learning (Majidah et al., 2024) (Prameswara & Pius X, 2023).

Instructional Media is all form tool or materials used in the learning process for help participant educate in understand and master material lesson. Purpose from use of learning media is for create experience learn more interesting and meaningful, so help participant educate in understand content lesson with more good. Learning meaningful can obtained through student - centered learning. Student- centered learning can obtained with application of the Problem Based Learning (PBL) model. Problem Based Learning capable facilitate student in to put forward opinion, analyze problems and thinking possibility in solve problem in fluid materials (Ramadhani, 2019). The PBL approach plays a role in develop ability cognitive student with breakdown problem, thinking critical and creative with apply knowledge cognitive, as well as process skills (Ardianti et al., 2021). The PBL model is one of the example implementation theory constructivism in practice learning. Constructivism is A theory learning that emphasizes that student in a way active build knowledge and understanding they Alone through experience and interaction with environment.

Theory This to argue that knowledge No can moved in a way direct from teacher to students, but rather must built by students That Alone. Based on background the back that has been outlined so researcher interested For develop suitable learning media for competence 21st century one of them is e-learning. E -learning is system learning that uses application electronics that play a role support the learning process teach with utilizing science and technology in the form of the internet, networks computers, or laptops. E-learning in research This developed with the PBL learning model which consists of above five syntax with objective capable increase HOTS skills and interests Study students. Based on results analysis needs carried out by researchers obtained

that 91.5% of students interested For learning with using e-learning. This e-learning developed for difficult material with objective student capable with easy understand the intended material.

2. METHOD

Procedure development e-learning physics based on PBL use Instructional Design ADDIE type in Details shown in Figure 1.

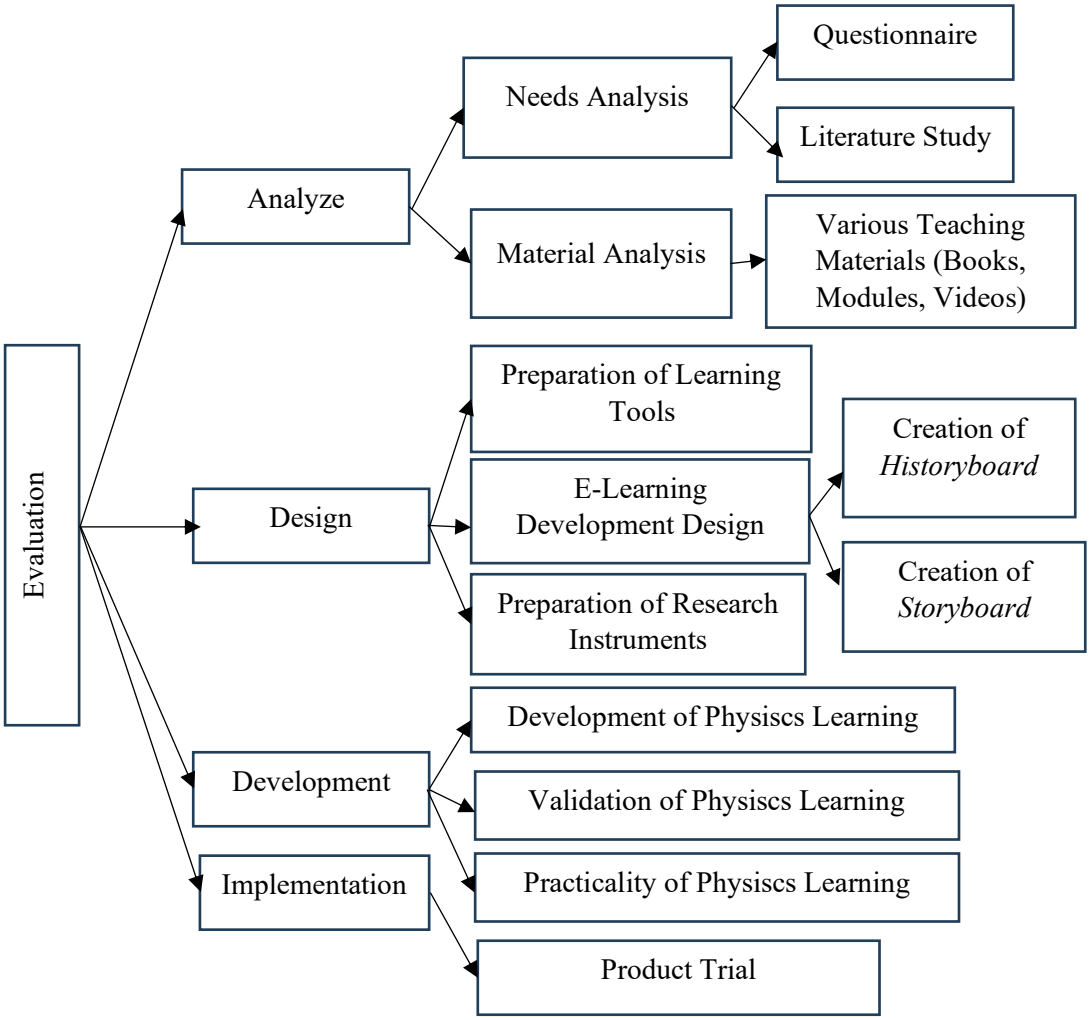

Figure 1. Procedure Development E-learning Physics

The Figure 1 study this done only until the practicality test stage. After e -*learning* physics based on problem based learning is complete developed so Validity and practicality tests were carried out to e-learning physics based on problem based learning on material fluid. Validity test aiming For to obtain e-learning physics material proper thermodynamics used in learning physics. Validity test conducted by 3 experts use sheet assessment consisting of on aspect pedagogy, materials, and media. Validation sheet as instrument data collection is provided to the experts (validators) who consist top 3 experts For know level eligibility from every products developed. Grid evaluation validity from e-learning physics based on problem based learning on material fluid can seen in Table 1 (Septiani et al., 2021).

Table 1. Grid Evaluation Validity from Learning Media

No	Aspect	Indicator	Number of Items
1	Pedagogy	Compliance teaching materials in e-learning with PBL syntax	5
		Compliance e-learning with HOTS aspects.	13
2	Material	Compliance Material with Curriculum	3
		Visual conformity with material	1
		Clarity order material	1
		Precision and accuracy material	3
3	Media	Legibility	4
		Visualization	4
		Compliance with character target	4
		Supporters presentation	1

The Table 1 validity test result data e-learning physics based on discovery learning analyzed use equation 1 is:

$$V = \frac{jumlah\ skor\ yang\ diperoleh}{jumlah\ skor\ maksimum} \quad (1)$$

This value then interpreted in a way descriptive based on Table 2 (Septiani et al., 2021)

Table 2. Categories validation

Index Validation	Category
$3.50 < \bar{x} < 4.00$	Very Valid
$3.00 < \bar{x} < 3.50$	Valid
$1.00 < \bar{x} < 3.50$	Invalid

Table 2 then do withdrawal conclusion which is conducted with how each component works e-learning assessment is declared valid if every component evaluation validation own minimum score of 3.00. If there is one of from indicator evaluation is in the score interval < 3.00 then category the stated invalid and must be done repair or revision on indicators the following is the next one validated return until valid. Further data obtained that is mark practicality e-learning physics based on PBL. Practicality sheet as instrument collection the data given to the users it consists of top 3 physics teachers SMA/MA level and 20 participants educate class. Grid evaluation practicality can seen in Table 3 and Table 4 (Sari & Mawardi, 2022) & Mawardi, 2022) and Septiani (Septiani et al., 2021).

Table 3. Grid Evaluation Practicality of Learning Media for Teachers

No	Aspect Evaluation	Number of Items
1	Convenience use	10
2	Effectiveness time	4
3	Benefit	6

Table 4. Grid Evaluation Practicality of Learning Media for Student

No	Aspect Evaluation	Number of Items
1	Convenience use	10
2	Uses of media	5

Table 3 and Table 4 qualitative data changed into quantitative data, then step furthermore in the form of determination mark practicality gained with use the formula in the equation:

$$\text{Practicality} = \frac{jumlah\ skor}{skor\ maksimum} \times 100 \quad (2)$$

Based on equation (2), researcher to obtain mark practicality from every developed products. This value Then interpreted in a way descriptive based on Table 5 (Riduwan, 2011).

Table 5. Criteria Evaluation Practicality

No	Practicality Value (P)	Criteria
1	$20 < P \leq 40$	No Practical
2	$40 < V \leq 60$	Less practical
3	$60 < V \leq 80$	Practical
4	$80 < V \leq 100$	Very Practical

Table 5 based on Table a product stated practical and feasible for conducted usage test scale big if all over indicator assessment on practicality has $P > 40$. However, if P value < 40, then product stated No practical so that need repair or revision to aspect the assessment concerned

3. RESULTS AND DISCUSSION

Study This produce product in the form of e-learning physics based on problem based learning on material fluid. Product This has through stage validation and practicality testing. Stage validation conducted by 3 lecturers expert in the Postgraduate Physics Education program, University of Riau. While the test, the practicality conducted by 3 physics teachers and 20 participants educated at SMAS Cendana Mandau. Development e-learning in study This only to the point practicality. The stages development e-learning in research this is as following:

3.1 Stage Analysis

Stage analysis consists of on 2 activities that is analysis needs and analysis material. The results of every activities at the stage analysis explained as following :

1. **Analysis Need**
   Analysis results need state that there is various problems in learning physics, including material physics specifically fluid is the material considered as hard learning understood by participants educate, where based on results analysis needs carried out by researchers obtained that 78% of students to argue that material fluid is difficult material For studied, results Study participant educate on aspects ability think level tall Still low, interest low learning as well as teaching materials that are too monotonous.

2. **Analysis material**
   Cendana Mandau Senior High School consists of on apply curriculum independent so development e-learning physics based on problem based learning customized with CP in the curriculum independence. Scope eye lesson physics high school level such as class XI covers a number of topics among others is material fluid and is in Phase F. Material fluid load sub material static fluid and fluid shared dynamic into 5 meetings. Meetings 1, 2, and 3 discussed about material static fluid, and meetings 4, 5 discussed about material fluid dynamic.

3.2 Design Phase

Development e-learning to be continued to stage design. At the stage design In this case, researchers also carried out 3 activities that is compilation device learning, design development e-learning physics, and compilation instrument research. The results of every activities at the stage design explained as following :

1. **Compilation device learning**
   Based on results from analysis analysis material, compilation guided teaching module to curriculum independence consisting of on control class teaching module and class teaching module experiment. Teaching modules used load a number of component like identity module covering eye lesson, unit education, classes, and allocation time. Core components include achievement learning, goals learning, Pancasila profile, material learning, core learning activities, and assessment learning. Appendices include material relevant reading, and glossary.

2. **Development design e-learning physics**
   Design process e-learning physics consists of top 2 steps that is to design historyboard and storyboard like shown in appendices 13 and 14. Historyboard covers part page opener, login, content or content and cover.

3. Compilation instrument study

Instruments used in the research This consists of on sheet evaluation validity, sheet evaluation practicality for teachers and participants educate, test ability think level height consisting of over 10 grains questions, and questionnaire interest Study participant educate.

3.3 Stage Development

E-learning based problem based learning that has been designed, then to be continued with stage development. Stage development covering stage making e-learning physics based on problem based learning, validation e-learning physics based on problem based learning, as well e -learning practicality physics based on problem based learning. The third one is stage in development of e -learning physics developed is as following. Creating physics e-learning based on problem based learning. Result of stage design is base for realize development e-learning physics based on problem based learning on material fluid. There is a number of activities carried out in development e-learning physics This that is arrange view, create material or content, and enter various material or content to in e-learning. The results of the creation e-learning can seen in Figure 2.

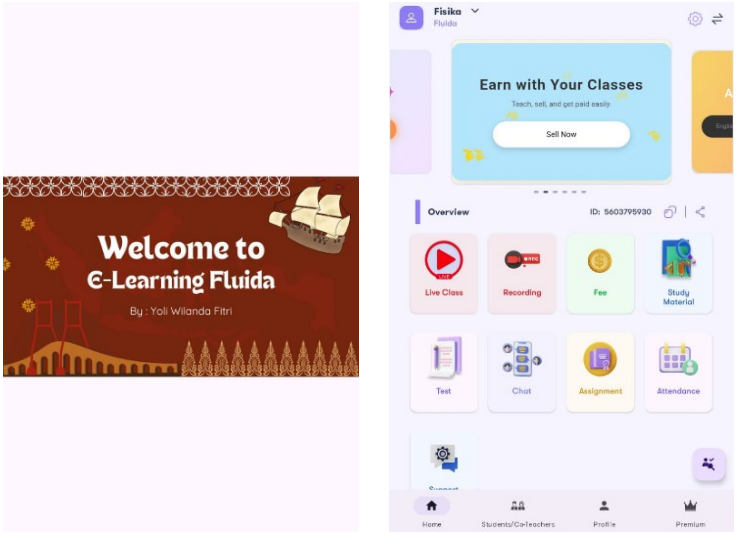

Figure 2. Display Opening and Closing E-learning

Figure 2 e-learning problem based learning developed covers teaching module, e- module fluids, LKPD, learning videos, quizzes, discussion forums and assessments summative.

1. E-module

   E- modules in e-learning found in every meeting, where the e- module was developed use canva then uploaded into the e-learning in pdf format. E- module arranged in accordance with Syntax problem based learning and loading indicator skills think level tall.

2. Video

   Videos on e-learning found in every meeting. Videos contained in e -learning this is adopted from relevant YouTube videos with material lessons on each meeting.

3. Worksheet
   LKPD on e-learning found in every meeting, LKPD developed use Canva then uploaded in pdf format.

4. Discussion forum
   Discussion forum on e-learning found in every meeting. Discussion forum developed with utilize features found in e-learning. Discussion forum this used for discussion together if there is difficulty or problems encountered by students or forum for convey information.

5. Quiz
   Quiz on e-learning found in every meeting. Quiz arranged with utilize available features in the e-learning. Quiz developed in multiple choice form, and each meeting there are 4 quiz items.

Contents section or content this is also equipped with assessment summative consisting of top 10 questions skills think level height consisting of on three indicators consisting of on analyze, evaluate and create and 5 grains question LOTS addition. Questions developed in form multiple choice.

3.4 Validation e-learning physics based on problem based learning

Physics e-learning that has been finished made Then tested eligibility or its validity based on sheet assessment that has been compiled by researchers. Validity test done with give sheet evaluation validity to 3 validators. The three validators are lecturer expert from from the Postgraduate Program in Physics Education, University of Riau. The validator conducted evaluation as much as 2 times on the aspect materials, media, and pedagogy based on aspects available on the sheet evaluation validity.

a. Media Expert Validation

Validation media experts consist of on 4 aspects, namely readability, visualization, appropriateness with characteristics targets and supporters presentation. The results validation media experts can seen in Table 6.

Table 6. Validation results media expert

Aspect	Validation Score	
	Before revision	After revision
Legibility	3.08	3.49
Visualization	3.08	3.41
Compliance with characteristics target	3.74	3.83
Supporters presentation	2.66	3.33
Average	3.14	3.51

Based on Table 6 obtained amount score validation before revision namely 3.14 and after revision 3.51. Based on category validity in Table 3.9 then criteria results validation aspect media

in e-learning physics that was developed before revision is in the valid category and after revision is in the very valid category.

b. Subject Matter Expert Validation

Validation expert material consists of on 4 aspects, namely conformity material with curriculum, visual conformity with material, clarity description materials, as well as precision and accuracy material. As for the results validation expert material can seen in Table 7.

Table 7. Validation results expert material

Aspect	Validation Score	
	Before revision	After revision
Compliance material with curriculum	3.10	3.66
Visual conformity with material	3.33	3.33
Clarity description material	3.66	3.66
Precision and accuracy material	3.33	3.33
Average	3.35	3.49

Based on Table 7 obtained amount total validation score which is 3.35 before revision and 3.49 after revision. Based on category validity in Table 3.9 then criteria results validation aspect material *e*- learning physics developed Good before and after revision is in the valid category.

c. Pedagogy Expert Validation

Validation expert pedagogy consists of on two aspects, namely conformity teaching materials in *e-learning* with step *problem based learning* and suitability *e-learning* with indicator ability think level high. As for the results validation expert pedagogy can seen in table 8.

Table 8 Validation results expert pedagogy

Aspect	Validation score	
	Before revision	After revision
Compliance teaching materials in e-learning with step problem based learning	3.06	3.39
conformity e-learning with indicator ability think level tall	3.10	3.66
Average	3.08	3.52

Based on Table 8 obtained amount score validation before revision namely 3.08 and after revision 3.52. Based on category validity in Table 3.9 then criteria results validation media aspects in physics e-learning before revised is in the valid category and after revision is in the very valid category.

3.5 Practicality e-learning physics based on problem based learning

Such as validity test, practicality test done with give sheet evaluation practicality to user. The user in question consists of over 3 physics teachers and 20 participants educated at SMAS Cendana Mandau. The researcher also explained method use e-learning physics based on problem based learning that has been developed. The results are teacher practicality can seen in Table 9 and the results practicality student can seen in Table 10.

Table 9. Results of Teacher Practicality Test

No	**Aspect**	**P**	**Criteria**
1	Convenience use	91.80	Very practical
2	Effectiveness time	84.80	Very practical
3	Benefit	87.60	Very practical
	Average	88.00	Very practical

Table 10. Practicality Test Results Student

No	Aspect	P	Criteria
1	Convenience use	89.40	Very practical
2	Benefits of media	89.60	Very practical
	Average	89.50	Very practical

Based on Table 9 results of practicality tests e-learning physics by 3 physics teachers to obtain the average value is 88.00 with very practical criteria. No far different with Table 10 states that average practicality value e-learning physics conducted by 20 participants educate of 89.50 with very practical criteria. Because average practicality value Already is in the very practical criteria as well as no there are suggestions from every teacher and participant educate, then e-learning physics in a way overall stated practical for used in the learning process physics.

4. CONCLUSION

E-learning based problem based learning developed covers teaching module, e-module fluids, LKPD, learning videos, quizzes, discussion forums and assessments summative on the material fluid to obtain score validation 3.51 on media aspect, 3.49 on aspect material and 3.52 in aspects pedagogy with very valid category. Based on practicality test results obtained score 88.00 for results teacher practicality and 89.50 for results practicality student with very practical category. Based on results validity and practicality so can concluded that e-learning physics based on problem based learning is feasible used For increase ability think level height and interest Study student in learning physics.

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