Development of Lectora Inspire to Identify Students' Conception Level on Vector

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Abstract – *The COVID-19 pandemic caused direct learning to be restricted. Due to the lack of interaction, the potential learning losses, such as mastery of concepts, become very large. Therefore, a diagnostic test is carried out so teachers know students' conception. Recently, a four-level diagnostic test was assessed effectively to reveal conceptions based on their answers, level of confidence in answering, giving a reason, and level of confidence in choosing reasons. However, implementing the diagnostic test was constrained directly, so the media needed to accommodate them. The purpose was to develop lectora inspire to identify the level of conception in vector. The ADDIE method is used. Quantitatively, the validity is calculated as a percentage and analyzed using a Likert scale. While qualitatively, suggestions for improvement are given by experts to be followed up. Additionally, a group test was conducted to determine the efficiency and practicality of the media. Based on this research, it is known that Lectora Inspire is declared to be valid, effective, and practical to use.*

Keywords: Lectora Inspire; Diagnostic Test; Conception Level; Vector

INTRODUCTION

The Covid-19 pandemic caused the implementation of education in Indonesia to be restricted. These restrictions are chosen to minimize the potential for transmission in the educational environment during learning. Through the policy of the Ministry, the direct learning process is stopped and replaced with online learning (e-learning).

According to Handarini & Wulandari (2020), e-learning requires an internet network, accessibility, and the ability to bring up various learning interactions. Even if it can reach a more expansive learning space, e-learning only occurs with obstacles. Syah (2020) explains that the factors of resistance to the effectiveness of e-learning are: a) limited mastery of technology, b) inadequate facilities and infrastructure, and c) limited internet access.

Additionally, the potential for learning loss for students is getting bigger. Because there needs to be more interaction between teacher and student in the educational process. Onyema (2020) argues that if the symptoms of learning loss are allowed to be continued, it can affect the mastery of concepts in Physics.

In general, mastery of concepts is defined as the ability of students to understand the true meaning of physical concepts, either through teacher explanations or other learning resources. Through these two learning resources, students are expected to be able to solve physics problems and make their learning more meaningful.

The understanding of students will increase if humans can sense the concept. In the Quantities and Units topic, the concept of mass can be sensed through the measurement instrument so the observer understands how big the mass of the fruit showed by the scale. In comparison, the concept of weight can be sensed when we hang a stone on the end of the balance measurement so the observer understands the value of the weight of the stone.

Meanwhile, some concepts cannot be sensed directly by an electric charge.

According to the convention, electric charge is illustrated by the shape of a spherical space. The lines of electric force are generated by positive charges (+q) and are directed away from the charge. If there is a negative charge (-q) around the positive charge, then the electric line of force released by +q will cause an attraction between them. If each concept being taught is not given an illustration, the students will have difficulty understanding the concept and will interfere with understanding the following concepts.

The misunderstanding conception can be known by the four-tier diagnostic test, which sequentially, this test contains (1) multiple choice, (2) the level of confidence in choosing answers, (3) the reason to answer questions, and (4) the level of confidence in choosing reasons.

Fariyani et al. (2015) said a four-tier diagnostic test has many advantages. It can distinguish the confidence level for choosing answers and reasons to identify a deeper understanding of students. It can diagnose the level of conception of each student deeper and determine the parts of the topic that requires more discussion. Lastly, it can determine the learning strategies to improve students' conceptions.

In the case of revealing students' conceptions, Gurel et al. (2015) classify the category of conceptions into five types scientific conception (SC), lack of knowledge guessing (LK-g), no understanding of conception (NU), misconception (MSC) and Un-Code (Un-C). The interpretation of students' understanding of categories through a four-level diagnostic test can be described as follows.
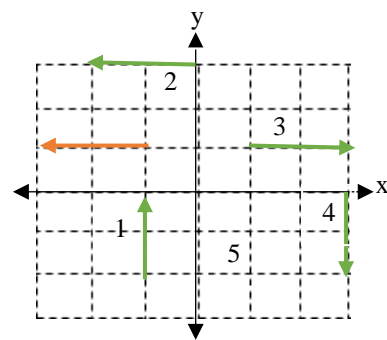
Table 1. The Description of Each Conception Level Categories

No	Answer Combination				Conception Level
	1st tier	2nd tier	3rd tier	4th tier	
1	True	Sure	True	Sure	SC
2	True	Sure	True	Not Sure	
3	True	Not Sure	True	Sure	
4	True	Not Sure	True	Not Sure	
5	True	Sure	False	Not Sure	
6	True	Not Sure	False	Sure	
7	True	Not Sure	False	Sure	
8	False	Sure	True	Not Sure	LK-g
9	False	Not Sure	True	Sure	
10	False	Not Sure	True	Not Sure	
11	False	Sure	True	Sure	
12	False	Not Sure	True	Not Sure	
13	False	Sure	False	Not Sure	
14	False	Not Sure	False	Sure	NU
15	False	Not Sure	False	Not Sure	
16	False	Sure	False	Sure	MSC
17	There is question that are not answered by the students or they answer more than one for available options				UnC

Another advantage of this test was revealed by Diani et al. (2019); the four-tier diagnostic test is a method for detecting misconceptions suitable for many students so the teacher can manage their time optimally. Substantially, the example of four tiers diagnostic test in the vector can be described in Table 2.

Table 2. Description of Each Question and Multiple Forms

Questions and Multiple Forms

Consider the vector A below. Determine the vector $\vec{A}'$ (⟶) which is the negative vector of vector $\vec{A}$ (⟶)?

1st tier is "question of vector topic"

Questions and Multiple Forms

a. (1)
b. (2)
c. (3)
d. (4)
e. (5)

2nd tier is "level of confidence for choosing answer"

a. Sure
b. Not Sure

3rd tier is "reasoning of choosing answer"

a. The negative vector always points toward the negative Cartesian coordinate axis
b. Negative vectors cannot exist, because vector values are always positive
c. Negative vectors may exist because the direction of the vector can be positive or negative
d. A negative vector is a vector that has the same value as its pair vector but in the opposite direction to each other
e. It is impossible for a negative vector to point to a positive Cartesian coordinate axis
f. A negative vector is a vector whose direction is always opposite to its partner vector and towards the positive Cartesian coordinate axis

4th tier is "level of confidence for choosing reason"

a. Sure
b. Not Sure

So far, the implementation of four tiers of diagnostic tests is given to the students directly. It means its implementation is based on the paper-based (written test). However, in pandemic conditions, it must be suitable to use the computer so that teachers can identify how deep the conception of each student is.

Using the computer takes work to apply. We must ensure its implementation can be held simultaneously to minimize the opportunity between students to exchange their answers. Therefore, an offline platform is needed to simplify the implementation of this test and be capable of accessing everywhere.

The platform referred to in this study is Lectora Inspire. It is interactive media learning that combines text, graphics, audio, images/animations, and videos into a unified whole.

Octavina & Susanti (2021) mention that one of the advantages of using Lectora Inspire is that it can provide various evaluations like (1) multiple choice, (2) true or false questions, and (3) make a match.

In addition, the existence of this software can be used to evaluate student competency (Shalikhah & Primadewi, 2017), especially in determining their conceptions in the vector which is assisted by four tiers diagnostic test and assessing the interactive media developed in this study.

RESEARCH METHODS

Kind of this research is education research and development (R&D), which aims to produce and evaluate the product, which must be valid and reliable.

The developed product evaluates students' conceptual understanding through diagnostic questions in this research. Test results' validity, practicality, and effectiveness are obtained based on the quantity conversion data like a scoring rubric. In contrast, the qualitative data was obtained by recommendation from the experts.

Procedurally, this research adapts the steps of ADDIE, which each step can be described in Figure 1.

In the analysis step, researchers have an opportunity to do a "need assessment" and formulate the aim of product development through preliminary study. Through these activities, researchers can compare a condition that should exist and factual conditions. If there is a gap between them, the researcher can find a solution by developing *Lectora Inspire*.

After the analysis session is done, the next step is design. There are two activities that the researcher must do. The first is to construct the conceptual design using physics literature and suit it with the current curriculum. The second is interface design which can be applied in *Lectora Inspire*. The user interface is the visual appearance of a product connecting the user and its system. It aims to improve the media to be attractive.

Figure 1. The Steps of ADDIE which Modified in This Study

The third step is development which aims to apply and make the media real. It evaluates the media through validation assessment and collects the data based on the experts' suggestions to improve it.
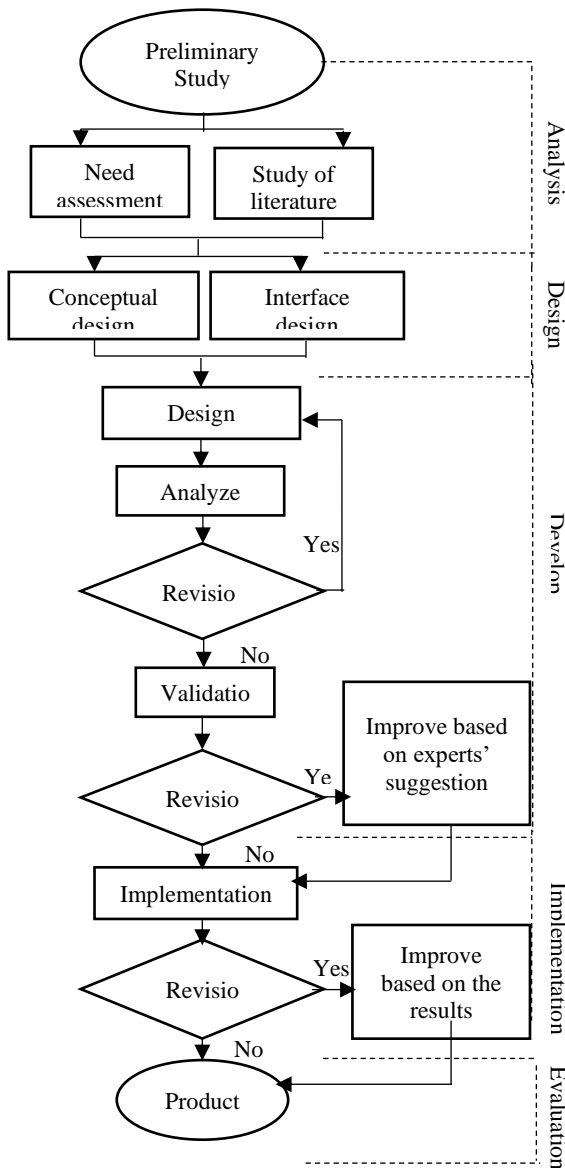
The fourth step is implementing a limited group to identify the student's response to using the media and identify the students' conceptual understanding of vectors.

The final step, called evaluation, is carried out to determine product deficiencies and weaknesses that can affect its validity and effectiveness.

After understanding all steps in this study, the data types analyzed are quantitative and qualitative. Quantitative data were obtained from the results of expert validation by scoring questionnaires and student response questionnaires. Meanwhile, the qualitative data were obtained through analysis using the media and the results of descriptive observations.

In its implementation, the research subjects whose role was in this study were students from SMA Dharma Wanita 4 Taman in classes X Science 1 and X Science 2. In the small group test, the number of students included was five to ten people. Meanwhile, the field experiment requires eleven to thirty people.

Talking about the validation assessment, several experts who can do this activity include (1) topic experts who assess products based on the truth of the concept, the suitability of the cognitive domain of diagnostic questions, and accuracy in applying pictures, tables, and graphs. In addition, topic experts also assess the use of language adapted to the General Indonesian Spelling Guidelines (PUEBI). (2) design experts assess how researchers choose typography, arrange the layout, and composition of illustrations used in the media. Finally, (3) media experts have the right to assess the feasibility of the product when tested in the field experiment session.

Furthermore, the data analysis technique used in this study is the calculation of the validity of the media and the analysis of effectiveness and practicality. Validity analysis is carried out to determine each aspect's feasibility, including the concept of topic, design, and media by the expert lecturers. Experts use a Likert scale to provide an assessment, as listed in Table 3.

Table 3. Likert Scale

Category	Score
Very good	5
Good	4
Acceptable	3
Poor	2
Very poor	1

(modified by Riduwan, 2019)

Meanwhile, the percentage of validity of the questionnaire filled out by the experts can be calculated by the following equation.

$$P = \frac{\sum X}{\sum X_i} \; x \; 100\% \qquad (1)$$

where,

P =   Percentage of media validity
$\sum X$ =   The number of answer scores per item
$\sum X_i$ =   The maximum total score per item

The results of this data are interpreted based on the assessment criteria adapted from Pilendia (2020) in Table 4 as follows.

Table 4. Criteria of Validation

Scoring Criteria (%)	Level of Validation
100	Very valid, can be used without improvement
85.01-99.99	Very valid, usable but needs minor improvement
70.01-85.00	Quite valid, can be used but must be improved
50.01-70.00	Not valid, it is recommended not to use because it needs a major improvement
01.00-50.00	Invalid, it should not be used

Besides the validation assessment of media, this research agenda also analyzes the effectiveness and practicality of using media. According to PUEBI, effectiveness is the compatibility between the aims of developing learning media and the goals of the current curriculum that have been set before. In comparison, the practice is defined as the ease felt by users during accessing learning media.

RESULTS AND DISCUSSION
Results

Besides the validation assessment of media, this research agenda also analyzes the effectiveness and practicality of using media. According to PUEBI, effectiveness is the compatibility between the aims of developing learning media and the goals of the current curriculum that have been set before. In comparison, the practice is defined as the ease felt by users during accessing learning media.

The output of this research is to develop Lectora Inspire for identifying the level of students' conceptions in vector. Before producing the media, the researcher carried out a preliminary study. The result shows several concepts needed to be further diagnosed because the percentage of students' understanding shows lower results than the researcher's expectation.

Some of the concepts assessed lower of mastery are; (1) the concept of displacement, (2) the concept of negative vectors, and (3) the concept of vector addition in two dimensions. Such concepts, by researchers, are used to be fundamental for developing instruments diagnostic tests in vector.

After the diagnostic questions are ready, the next step is to design how Lectora Inspire technically and operationally to be feasible. It is called feasible technically if the program is considered relevant to the

development aims, and it is called operationally feasible if it is considered to be capable of providing solutions to solving problems, in this case, being able to reveal the level of students' conceptions of the vector (Mahmudah & Pustikaningsih, 2019).

The design of Lectora Inspire starts with making storyboards and storylines. According to Shalikhah & Primadewi (2017), the storyboard is a visualization of ideas created to provide an overview of the application. In contrast, the storyline is a story that will be presented to the media.

After creating them, the next step is the production process, whose all concepts will be combined and suitable for the menu structure. The researcher's capability to process each component can reveal how sensitive the researcher finds the solution. When its production is complete, Lectora Inspire will be ready to be published and tested for feasibility.

The feasibility test is a validation from the experts. Concept experts assess several aspects; there is (1) learning design, (2) the depth of revealing students' conceptions, and (3) language structure. The design assessment aims to identify the suitability of the test items with basic competencies and learning objectives. In addition, the systematics and consistency of the concepts tested (from simple concepts to more complex concepts) were well prepared.

First, the results of the concept expert's validation are described in Table 5.

Table 5. The Results of Concepts Expert's Validation

No.	Item	Percentage
1	Learning Design	92
2	Conceptual Mastery	91
3	Language Structure	100
	Average Percentage (%)	94

Design experts carried out the second validity test. This validation activity evaluates the user interface, called visual appearance, which evaluates the form of shape, color, layout, or typographical letters that must be attractive and suitable.

Dinar & Waluyo (2016) said constructing a user interface is crucial. Considering the development of interactive media to identify students' conception level, the intended user interface design must be able to accommodate its needs in the evaluation process.

For example, the commands on each system button, such as "start," – "click," – "back," – "discussion," must be functional. Because the user interface can be seen and touched, adhering to the principles for designing user interfaces is necessary.

Its principles are as follows: 1) user familiarity (easily recognizable), called the terms of concepts according to students' cognitive level. 2) the layout is arranged by adjusting the appearance of the center of view (point center) to give a harmonious and proportional impression, and 3) user diversity, called the provision of interaction facilities for different types of users, such as their font size.

Another component that must be considered is the selection of illustrations, the layout of letters, and the selection of color gradations, among others. The results of the design expert validation are presented in Table 6.

Table 6. The Results of Design Expert's Validation

No.	Item	Percentage
1	User Interface Design	86
2	Content Design	89
	Average Percentage (%)	87

The final work of the validation process comes from a media expert. This test evaluates the compatibility of the Lectora Inspire media. Compatibility means the ability of media to combine text, graphics,

audio, and moving images. So, it can optimize users to navigate and interact very well.

This aspect assessed in these activities is 1) portability, which must be easy to install and easy to access, 2) usability, which is easy to use; 3) functionality, which means that various components can be operated; also 4) visual communication and interactivity must be suitable with the text and the quality of illustrations. The results of this validation can be described in Table 7.

Table 7. The Results of Media Expert's Validation

No.	Item	Percentage
1	Portability	100
2	Usability	88
3	Functionality	93
4	Visual Communication and Interactivity	90
	Average Percentage (%)	93

After the validation process, the product is ready to be tested in two steps: a small group and field tests. Focus assessment in small group tests is the feasibility of the product in terms of effectiveness, efficiency, implementation, and concept.

In the case of determining respondents, Sudarsana (2018) said that the researcher must consider their characteristics. Some of their characteristics are cognitive development, pre-conception, and social status. These characteristics are designed to be variative. It aims to accommodate every potential in this study, such as the intellectual abilities and the gender of students. The results of the small group test are listed in Table 8.

Table 8. The Results of Small Group Test

Questionnaire Items	Respondent Score					
	x_1	x_2	x_3	y_1	y_2	y_3
1	5	5	5	5	5	5
2	4	3	4	3	4	5
3	5	4	5	4	4	4
4	4	4	5	4	5	5
5	3	4	3	4	5	5
6	5	4	3	4	5	3

Questionnaire Items	Respondent Score					
	x_1	x_2	x_3	y_1	y_2	y_3
7	4	5	4	5	4	5
8	5	5	5	5	3	4
9	5	5	4	5	5	5
10	5	4	3	5	4	5
Obtained Score $\left(\sum X_i \right)$	358					
Total Score $\left(\sum X \right)$	400					
Effective and Practical	89,5					

Where

x_n : The n-th boy student
y_n : The n-th girl student

After doing the small group test, the next is a field test. There is a difference between the small group test and the field test. The open questionnaire is used in small-group tests. It aims to allow the students to provide suggestions and comments on the developed media.

While in the field test, the questionnaire used is closed, meaning statements are given according to their experience. In addition, questionnaire items are added to the field test, which is compiled based on suggestions and comments from students obtained from the previous step.

Focus assessment on field test as same as a small group test. Octavina & Susanti (2021) said the items which must be evaluated on field tests are: implementation, sustainability, effectiveness, acceptance, and attractiveness. Furthermore, in Table 9, the results of the extensive group test can be described as follows.

Table 9. The Results of Field Test

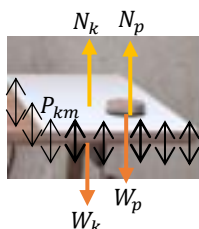| $\sum n$	X_i	X
25	1576	1750
Effective & Practical Score (%)		90

Discussion

Fitriani et al. (2020) argue that expert questionnaire scores can identify the feasibility of developed media. Meanwhile, the researcher must improve it based on experts' suggestions to increase its performance in identifying students' conceptions.
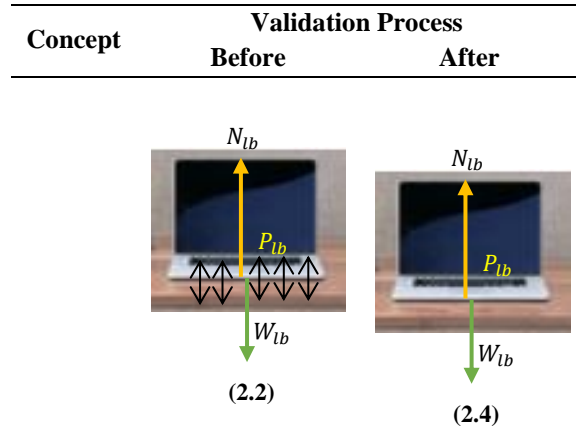
The first suggestion comes from a concept expert. The revisions which are noted in this validation process include 1) the suitability of the cognitive level, 2) visualization of how physical quantities work, 3) the accuracy of the symbols of physical quantities used, 4) the accuracy of the types of diagnostic test items selected, 5) the suitability between items test with answer options and 6) the accuracy of the selection of supporting information used in the diagnostic test items. The suggestions are followed up in Table 10.

Table 10. The Improvement Media based on Concept Expert's Note

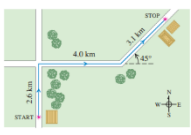| Concept	Validation Process	
	Before	After
Vector Quantity	(C2) Detailing the characteristic of vector quantities	(C4) Defining the characteristic of a vector quantity based on its principle
	Reason: Replacing cognitive operational word "detail" into "define". Fundamentally, diagnostic test is designed to be higher level to identify students' conception. If it needs a reason, indirectly, it improves their thinking skill to be complex.	

(2.1)

Concept	Validation Process	
	Before	After
Force vs Pressure	(2.2)	(2.4)

Where:

W_{lb}	:	Weight force of laptop (N)
N_{lb}	:	Normal force pressure (N)
W_k	:	Weight force of paper (N)
N_k	:	Normal force of paper (N)
W_p	:	Weight force of eraser (N)
N_p	:	Normal force of eraser (N)
P_{km}	:	The pressure exerted on the table surface by the paper surface (N/m^2)
P_{lb}	:	The pressure exerted by the surface of the table by the bottom surface of the laptop (N/m^2)

Reason:
Improvements to the visualization of physical quantities that should be simple because the classical mechanics which used is two dimensional review.
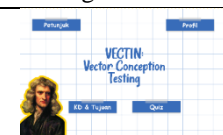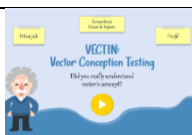
Concept	Validation Process	
	Before	After
Notation of Magnitude	Vector notation is described by single letter, bold print, italic font, and there is an arrow on it. For example $\vec{\boldsymbol{A}}$	Scalar notation is described by single letter, light print, italic font without an arrow on it. For example A
	Reason: Using physics magnitude notation must obey the reference which used to be universal. It means that it must close to be absolute and suitable with scientist theories.	
Displacement	Prediction of displacement direction	Calculation and prediction of displacement direction

Concept	Validation Process	
	Before	**After**
	A postal employee drives a truck along a route below! What is the direction of movement? a. southeast b. northeast c. northwest d. east e. south	A postal employee drives a truck along a route below! Determine the displacement of the truck from the start point to the stop point! a. 6.1 km north b. 7.9 km northeast c. 9.7 km northeast d. 11.2 km north e. 12.1 km north
	Reason: The question items have potential to be explored more deeply, it aims to test numeracy skills. These skills include the ability of students to determine the value of the displacement with the correct equation.	
Two-dimensional displacement	There are eight car tracks that are directed in various directions and are indicated by colored arrows (⟶) from the origin (O) as shown below:	There are eight car tracks that are directed in various the origin (O) as shown below:
	Reason: For supporting information on the question items must be adjusted to the needs.	

Meanwhile, the design expert also gives an improvement note to the researcher. There are media backgrounds, media typography, and menu layout. These improvements are described in Table 11.
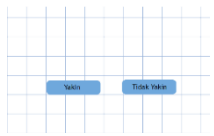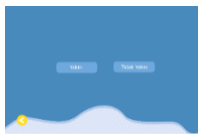
Table 11. The Improvement Media based on Design Expert's Note

Item	Validation Process	
	Before	After
Color Gradation		
	Reason: The expert considered that the learning media designed as an evaluation tool should give the impression of calm in thinking. It comes from blue color.	
Layout Efficiency		
	Reason: There is reduction sub menu to make it more efficient than before.	
Typography		
	Reason: Adding an explanation statement in "Petunjuk" sub menu.	

Lastly, an improvement has come from media experts, which must be revised in each part; there are submenu efficiency and additional button choices for media interface. It aims to simplify user interaction. Here the results of this improvement can be described in Table 12.

Table 12. The Improvement Media based on Media Expert's Note

Item	Validation Process	
	Before	After
Sub menu Efficiency		

Item	Validation Process	
	Before	After
Add inter face button	Reason: The researcher added a new sub menu, there is display of the concepts which will be tested. It also directs user to certain questions so they can more focus.	
	Reason: The improvement referred in this case is the addition of a "back" button on each diagnostic question. This intended to provide opportunities for students review their answer choices before submitting them to the system.	

CONCLUSION

The researcher chooses Lectora Inspire to develop them in case evaluating the conception level of the students is effective. There are some excellences of lectora inspire: it can be published into various outputs, is compatible for use in the learning management system (LMS), is easy to use (user friendly), and is able to make quizzes to identify students' conception levels.

However, the development of this media cannot be avoided from the weaknesses that exist in the system. It should be improved to be better. There is no supporting software such as Flash player and time stopper which aims to make Lectora Inspire more varied through games. The device (computer/laptop) needed to develop this media must have a high processor because it will affect the speed of the application during use.

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