Developing A-Chemistry-Online Learning Based On Learning Technology System Architecture (LTSA)

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***Abstract*— A more effective and efficient learning system is needed to facilitate the interaction between teachers and students because in general after-school learning activities are completed; there is no interaction between the teacher and students. The use of mobile technology that is currently ever more popular needs to be optimized for positive things, especially in supporting the learning and teaching process. Distance learning system based on Learning Technology System Architecture (LTSA) aims to facilitate communication and collaboration. We built online learning that provides 24-hour learning solutions so that learning continues to run even though the normal class has finished. Chemistry subjects are one of the subjects that are considered difficult for students and require more study time. From the results of testing the application using the questionnaire, the results of the average value of all questions are obtained without being classified based on user verification, which is 80.03% while the average of all questions based on teacher verification is 83.64%.**

Keywords-distance learning; LTSA; chemistry; online learning

I. INTRODUCTION

Education is a conscious and systematic effort carried out by people entrusted with the responsibility to influence the students, so they will have a good character that fit with the mission and vision of education. In another word, education is the maturation of students so they can develop their talents, potential, and skills in living life. Therefore, it has become a necessity for education to be designed to provide understanding and improve student achievement. Chemistry subjects are one of the subjects for high school students who are one of the main subjects in natural science. Success in these subjects is essential for every student.

Classical methods in school are based on standard lectures and does not provide access for students to think systematically because the subject matter tends to aspects of memory, the problems that exist in the classroom are teacher-centered so that it creates student saturation during learning activities and low student activity when learning chemistry is impressed boring all this time. Based on these problems it is necessary to apply learning methods that require students to be active, one of the recommended methods is a problem-solving method based on Learning Technology System Architecture (LTSA).

Online classes allow a student to study without depending on place and time and allow the student to get lifelong learning [1], [2]. The delivery of good learning material on the E-learning system will be more and more interesting, with the fact that the quality of internet services in Indonesia is getting better. With the better means of supporting e-learning, rapid response to every learning problem in students will be easy for teachers and managers to make improvements during the teaching-learning process without the need to wait for a long process.

Based on these problems it is necessary to apply learning methods that require students to be active, one of the excellent learning systems is Learning Technology System Architecture (LTSA) based learning. At this stage of e-learning design is combined with LTSA. LTSA, IEEE 1484 is an international standard of learning system developed based on the IEEE 1484 Learning Standards Committee (LTSC) by the Incorporation License, Edutool division. The LTSA specifies five layers, but only layer 3 is normative. Each layer describes a system at a different level. Higher layers have higher priority and influence in system analysis and design. In the LTSA system architecture, there are five layers, but only layer 3 is the normative layer, the other layers include the informative layer. The use of LTSA as a supporter of the e-learning design stage to improve effectiveness in application development [3], [4]. LTSA includes a comprehensive system commonly known as learning technology, education, and technology training, computer-based training, computer-assisted instruction, intelligent tutoring, metadata. This architecture is neutral to aspects of pedagogy, content, culture, and platforms of a teaching system. The development of this system is optimized for mobile hardware to support user mobility. By focusing on mobile systems, it is expected that application coverage can be further improved.

Our chemistry learning media have designed several quiz models to justify and measure the students 'understanding of all the material/module provided by the teacher. In the discussion, the application will process, each question from the student. These questions will be sent directly to the teacher, so the teacher can explain the material that has not been understood by students. In practice questions, this application will process the questions entered by the teacher. The execution of this exercise is based on the time determined by the teacher. The value of the results of the workout of the problem training will be stored as training value data and displayed in the student application, for information about the execution of the test exercises will be known directly by the teacher.

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II. PROPOSED METHOD

A. Design of System Architecture LTSA

There are three components that are the main basis for an LTSA architecture, namely process, media, and flow. The process is an activity that will accept input, process input, and then produce output. For media itself is a storage area which is a media that can store information, information can be searched and can also be updated. While the flow can be interpreted as connectivity (one direction, two directions) between entities that carry information. We use the third layer because only layer 3 is normative. Each layer describes a system at a different level. High layers have higher priority and influence in system analysis and design. In the LTSA system architecture, there are five layers, but layer three which is the normative layer and the other layers include the informative layer. Figure 1 Describes the components of the LTSA architecture in the third layer that is Normative. Normative is the term used in the LTSA as a clue to the system specifications technically on the implementation to be carried out. While informative is a term that is quite helpful in designing the architecture, but it is not something that is needed to understand the contents of the standard LTSA. The structure does not include technical specifications and does not originate from an integrated part of the standard LTSA [1].

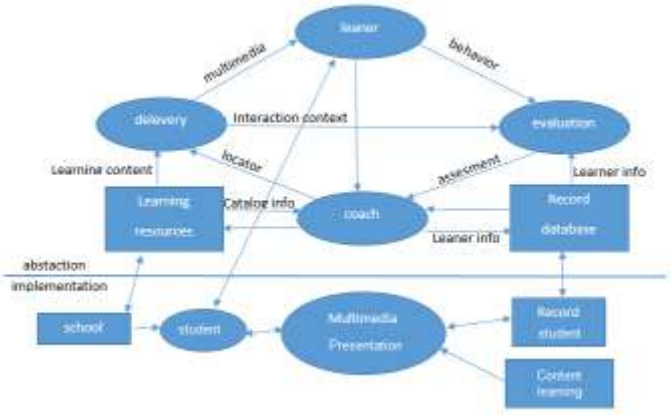

Figure 1. Components of the LTSA architecture [1]

The physical architecture of the application can be seen in Figure 2. A system architecture designed to enable teachers to be still able to interact with students both at school and at home, teachers can also provide material and questions through the system or server [5].

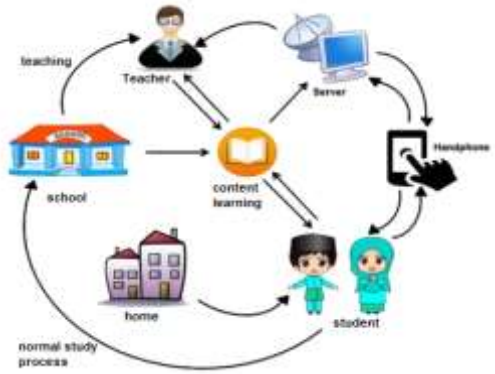

Figure 2. The architecture of the physical system

Students can also do tests/quizzes about the material that has been studied. The teacher answers the questions asked by students. This FAQ process requires internet which will be displayed directly on the mobile Android system. The teacher also manages question exercises to test students' abilities. The process of training this problem also requires the internet as a means to connect Android to the server so that it can be done anywhere.

B. Design of LTSA Module

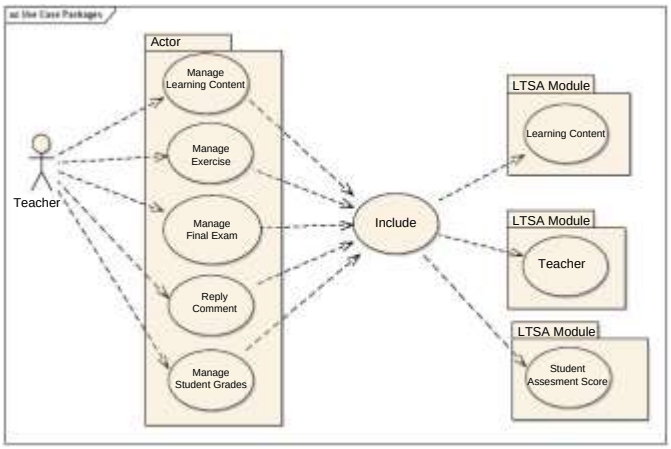

Figure 3. Design of module for the teacher

Figure 3. describes the module for the teacher that is in the LTSA module layer in the 3rd layer. Namely, there are Materials, Questions, and Student Values and Comments. For the explanation as follows:

1. Material: the teacher can use the material in the form of files and descriptions of the material on the application that has been inputted through the server as a learning resource for students.
2. Problem: The teacher can add questions and change the problems on the server to be displayed in the chemistry learning application.
3. Student Values: in this module, the teacher can monitor student grades and will record student learning outcomes or student achievements in the form of values from the system which will later become a reference for students to improve student learning activities later. In this module, the teacher can see the results of student achievements in the form of values on the server that is already available, where the teacher can provide conclusions whether the student's achievement has increased or not
4. Comments: In this module, the teacher can reply or hold discussions with students through teacher comments.

Figure 4. describes the student module that is designed in the LTSA module layer in the 3rd layer. Namely, there are delivery (submission of material learning), learner entity (material learning and questions), and evaluation (grading).

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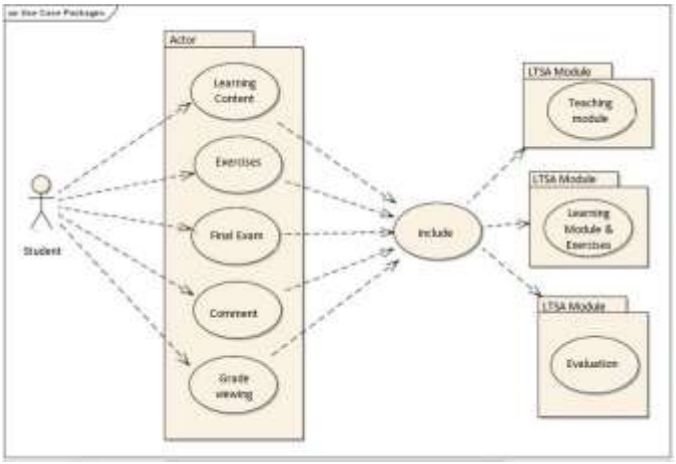

Figure 4. Design of LTSA module for the student

Figure 5. describes the use-case system diagram with the following information:

The features that owned by Admin:

- Admin can manage users such as adding, deleting or editing user data.
- Admin can manage content where the existing content server can be added, deleted and changed according to system requirements.
- Admin can manage material by editing, adding or deleting
- the material in the system is either server or client.
- Admin can add, edit and delete existing problems with the system with the appropriate questions on the material.
- Admin can add, delete, and change final exam questions and give value to students.
- Admin can reply to comments that have been sent by students.
- Admin can see student grades

The features which owned by the teacher:

- Teachers can manage users such as adding, deleting or editing user data.
- The teacher can manage the material by editing, adding or deleting material in the system both on the server and on the client.
- The teacher can add, edit and delete existing problems with the system with the appropriate questions in the material.
- Teachers can add, delete, and change the final exam questions and give grades to students.
- The teacher can reply to comments that have been sent by students. The teacher can see the grades of students.

The features of the User are as follows:

- Users can view and read material in the application.
- Users can work on the problem and find out the right and wrong answers directly.
- Users can work on the final exam questions to find out their abilities.
- Users can see the final value of either the daily question value or the final exam question that the students have done.
- Users can comment or ask questions about material that is not understood.

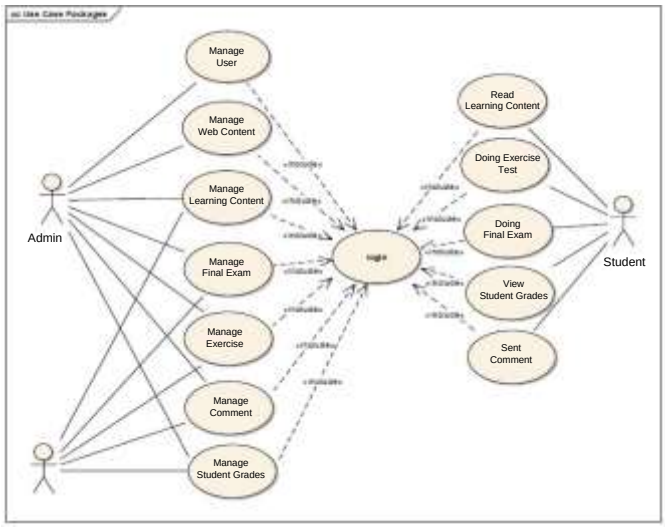

Figure 5. The use-case diagram of the system

III. RESULTS

In this section, we will explain the results of the developed system which utilize the LTSA in online learning of Chemistry subject. There are two systems that have been created; the web-based server system and client system which deployed on the mobile android system. Some examples of User-Interface (UI) software which has successfully developed are in figure 6 – 10.

Figure 6. User-interface of the login system

Figure 7. Section result of Data Page UI on the server

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Figure 8. Admin home page

Figure 9. Starting page on the client (*Android system)

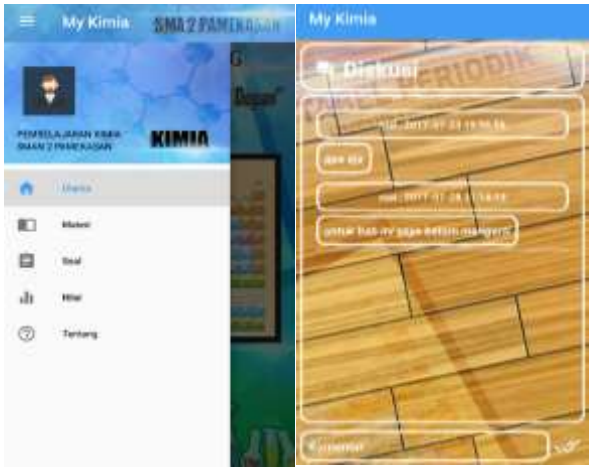

Figure 10. Client chat and learning content design results

A. *Hardware Implementation result*

Testing on different hardware includes the following tests: Installation, application, opening application, Showing Splash screen, Viewing material. Display questions, download material, view grade and do discussions. The test results on many hardware show smooth results without any problems; the details are as follows:

- Asus Zenfone Laser 2, Xiaomi Redmi 3, Xiaomi Mi 4i, the results are smooth without problems.
- The Lenovo A7000 failed to operate.

From the results of the experiment, it shows that the application is suitable only for hardware that has an operating system above Android KitKat (4.4.4). Hardware component specifications do not affect the running of the system.

B. *Measurement of user satisfaction*

This questionnaire was given to 30 students from SMAN 2 Pamekasan for evaluating the application. The questionnaire contains a statement regarding the use of chemistry learning applications by students. Calculation of the questionnaire results using the Likert scale feasibility test with the following conditions [6]:

TABLE I. WEIGHT VALUE OF LIKERT SCALE

Answer	Weight Value
Strongly agree (SA)	5
Agree (A)	4
Less Agree (LS)	3
Disagree (D)	2
Very Disagree (VD)	1

The results of the questionnaire application for chemistry subjects from students are shown in Table II and Table III.

TABLE II. STUDENT KOUISIONER RESULTS

No	Statement	Alternative Answers					Total Score	Y	% Score
		SA (5)	*A (4)*	*LS (3)*	*DS (2)*	*VD (1)*			
1	Statement 1.	15	32	13	1	0	244	305	80
2	Statement 2.	13	34	12	2	0	241	305	79,02
3	Statement 3.	14	33	13	1	0	243	305	79,67
4	Statement 4	8	36	15	2	0	233	305	76,39
5	Statement 5	10	34	16	1	0	236	305	77,38
6	Statement 6	17	33	10	1	0	249	305	81,64
7	Statement 7	16	27	16	2	0	240	305	78,69
8	Statement 8	15	32	14	0	0	245	305	80,33
9	Statement 9	22	32	7	0	0	259	305	84,92
10	Statement 10	16	36	9	0	0	251	305	82.30
Average									80.03

TABLE III. TEACHER KOUISIONER RESULTS

No	Statement	Alternative Answers					Total Score	Y	% Score
		SA (5)	A (4)	LS (3)	DS (2)	VD (1)			
Functionality Variable									
1	Statement 1.	1	1	0	0	0	9	10	90
2	Statement 2.	0	2	0	0	0	8	10	80
3	Statement 3.	2	0	0	0	0	10	10	100
4	Statement 4	1	1	0	0	0	9	10	90
Efficiency Variable									
5	Statement 5	0	2	0	0	0	8	10	80
Usability Variable									
6	Statement 6	0	2	0	0	0	8	10	80
7	Statement 7	0	2	0	0	0	8	10	80
8	Statement 8	0	2	0	0	0	8	10	80
9	Statement 9	0	1	1	0	0	7	10	70
Portability Variable									
10	Statement 10	1	1	0	0	0	9	10	90
11	Statement 11	1	0	1	0	0	8	10	80
Average									83.64

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The calculation is done using a formula:

$$Total\ Score = T * Pn. \quad (1)$$

$$Y = Highest\ score * number\ of\ respondents. \quad (2)$$

$$Percentage\ score = (Total\ score / Y) * 100 \quad (3)$$

TABLE IV. FEASIBILITY CONVERSION RESULTS

No	Percentage	Interpretation
1	0 % - 19,99 %	Strongly Disagree
2	20 % - 39.99 %	Disagree
3	40 % - 59.99 %	Disagree
4	60 % - 79.99 %	Agree
5	80 % - 100 %	Strongly agree

By looking at table 5, it can be concluded that the application has received an excellent response from users since the average satisfaction is above 80%. Thus, we may get the conclusion that users are very satisfied with the application performance.

IV. CONCLUSION

From the results of the application test using the questionnaire, the results of the average value of all questions are obtained without being classified based on user verification, which is 80.03% while the average of all questions based on teacher verification is 83.64%, and the application has received a very good response from users with very satisfied values.

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