ISSN No:-2456-2165

Development Practices Content Learning System Based Discovery Learning on Atomic Structure and Periodic Systems of Class X Vocational School to Higher Order Thinking Skills

Sinta Rahmatika Putri[1)], Rahadian Zainul[2)], Minda Azhar[3)], Ananda Putra[4)]
[1), 2), 3), 4)]Kimia, Fmipa UNP

Abstract:- A content learning system based on discovery learning is an electronic learning process using web learning and combining discovery learning models. The purpose of this study was to develop a discovery learning-based content learning system on the atomic structure and periodic system of class X SMK to improve students' practical thinking skills. This research model uses the ADDIE development model. This research is limited to the implementation stage, which is to see the practicality of a discovery learning-based content learning system that is tested on a limited basis. Based on the practicality test results of the discovery learning-based content learning system by going through two assessment data, namely the first teacher response questionnaire data with an average value of k is 0.89 very high categories, and secondly, the student response questionnaire data with an average value of k is 0.88 very good category. It was concluded that the content learning system based on discovery learning on the material of the atomic structure and the periodic system of the elements produced was said to be practical.

Keywords:- *Practicality, Content Learning System, Discovery Learning, Atomic Structure And Periodic System Of Elements, Higher-Order Thinking Skills.*

I. INTRODUCTION

The developments and advances in technology at this time are extraordinary, of course, some can produce positive things and negative impacts. One of the positive impacts is the use of media and information that can be accessed in various places with an internet connection [1], [2], [3]. Information Technology (IT) is growing very rapidly. Information Technology (IT) is growing very rapidly. This has an influence on the development of various fields of human life, including trade/business economics, social, health, education, transportation, banking, and others. The field of education is one that is influenced by IT development [4], [5].

One of the impacts of IT development in education is the development of an electronic learning system (e-learning) to increase the effectiveness and efficiency of learning to improve the competence and quality of human resources [6], [7]. As it is known that the learning process consists of dependence on one another. Because of the concept of distance learning, web-based E-Learning systems emerged when this system was used to support new functions of ordinary learning in general [8], [9].

E-learning has developed from the phase of utilizing smart devices to access digital content that is in a virtual learning system [10]. For learning, mobile devices and computers can be used, and online courses are in the hands of the world and can be used at any time [11].

LMS or better known as the Learning Management System is a software or software for administrative purposes, documentation, activity reports, teaching, and learning activities and online activities (connected to the internet), E-learning and training materials. And all these things are done online [12], [13], [14]. The development of e-learning products is carried out by the development of the Berg and Gall method. The application used is MOODLE (Modular Object-Oriented Dynamic Learning Environment) as a Learning Management System (LMS). The Moodle application is Open Source and many more are stable and easy to configure as needed in learning [15], [16], [17], [18].

The 2013 curriculum in its application requires students to be more critical and creative. Of course, this also applies to learning chemistry in schools. Chemistry learning is learning that emphasizes abstract concepts and abstract concepts that are difficult to explain with concrete examples [19]. Although the phenomena in this concept can be observed visually, for further explanation we need a special method that can describe these phenomena in real terms and are easy to understand [20]. One of the methods used is by using a learning model that can improve critical thinking and student learning outcomes in accordance with the scientific approach, one of which is the discovery learning model [21], [22], [23], [24].

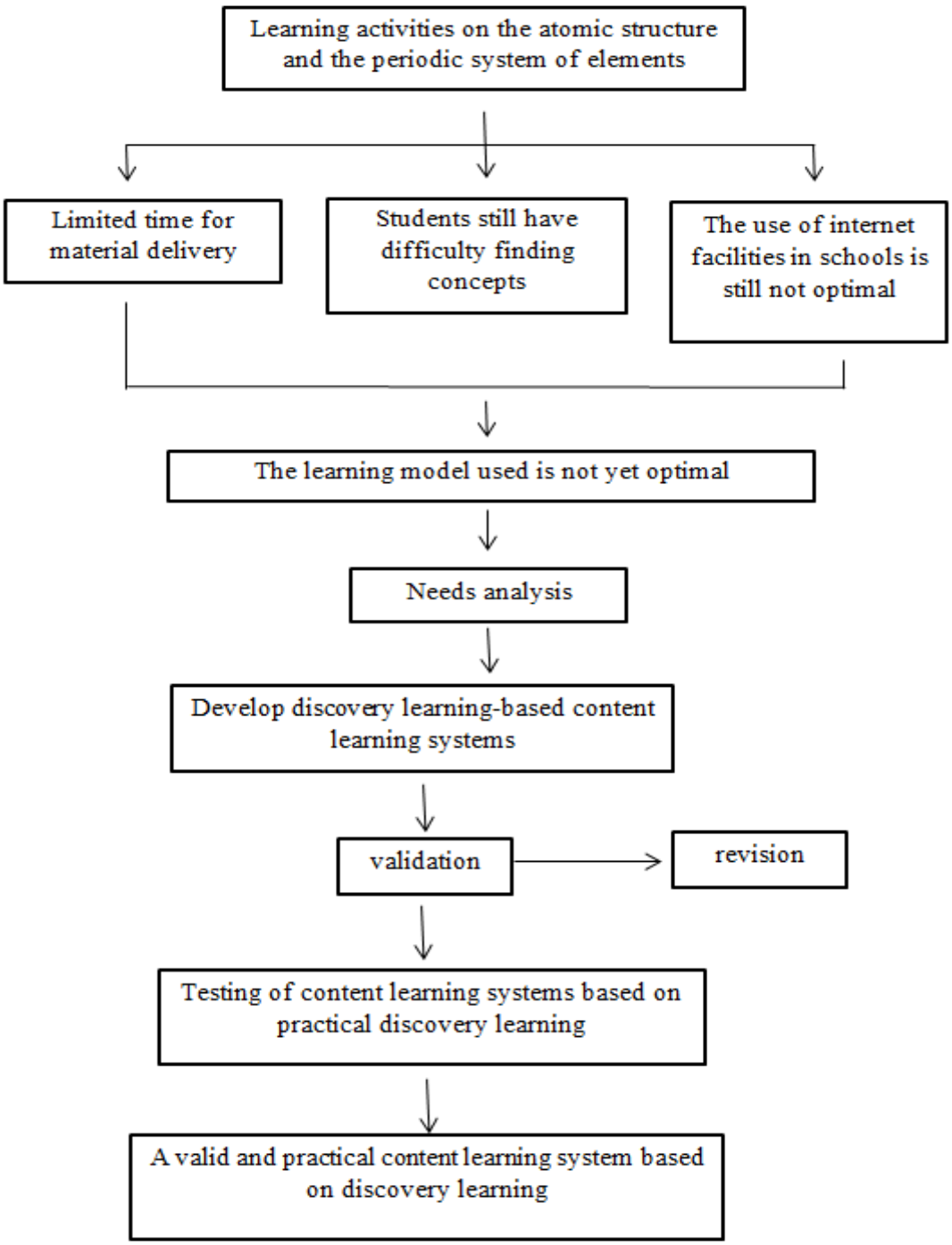
The material of the atomic structure and the periodic system of elements is included in the X grade chemistry subject of SMK. This material discusses the development of atomic models, atomic structure, and electron configurations. To be able to understand this material

students have to do a lot of practice questions to make it easier for students to understand the concept and how to write electron configurations and the location of elements in the periodic system [25]. Therefore, this material must be really understood by students by studying repeatedly and doing a lot of practice questions.

From the results of interviews with researchers with several chemistry teachers at SMK in the field of technology, and engineering expertise, it was found that the chemistry lessons at SMK were few while the material that students had to master was quite a lot. For this reason, additional learning is needed so that students better understand the concepts in chemistry material.

II. METHODOLOGY

This type of research is research development (Research and Development) which aims to see the quality of a practical product [26]. The product developed in this study is a discovery learning-based content learning system . The development stage of the discovery learning-based content learning system uses the ADDIE model [27]. The research steps can be seen in the following flow chart.



ISSN No:-2456-2165

The subjects in this study were students of class X TKR of Public Vocational High School 1 Pantai Cermin with a total of 33 students. The research instrument is in the form of teacher response questionnaire sheets and student response questionnaire sheets. The questionnaire uses a Likert scale according to the choice of answers or responses on a measuring scale, namely 5 is strongly agreed, 4 is agreed, 3 is sufficient, 2 disagrees and 1 strongly disagrees.

Data analysis techniques for content learning systems based on discovery learning can use the Kappa Cohen formula, where at the end of the processing a kappa moment is obtained [28].

$$moment\ kappa\ (k) = \frac{P - Pe}{1 - Pe}$$

Information :
k = moment kappa which shows the validity of the product
P = The realized proportion is calculated by dividing the number of values given by the validator by the maximum value
Pe = The unrealized proportion is calculated by reducing the maximum value by the total value given by the validator divided by the maximum value.

Table 1. Decision Category based on Moment Kappa (k)

Interval	category
0,81 – 1,00	Very High
0,61 – 0,80	High
0,41 – 0,60	Moderate
0,21 – 0,40	Low
0,01 – 0,20	Very Low
≤ 0,00	Invalid

Data analysis techniques for practicality of students on discovery learning-based content learning systems can use the Likert scale formula [29], where the steps are
a. Give a score for each answer item.
b. Add up the total score for all indicators.
c. Practicality analysis is used with percentage values (%)

$$\text{Practicality value} = \frac{\text{the number of scores obtained}}{\text{the maximum number of scores}} \times 100\%$$

d. Determine the criteria for product practicality

After the percentage of practicality is obtained, grouping is carried out according to the criteria for money in the following table.

Table 2. Criteria for giving practicality value

No	Percentage (%)	Criteria
1	0-20	Not practical
2	21-40	Less practical
3	41-60	Pretty practical
4	61-80	Practical
5	81-100	Very Practical

III. RESULTS AND DISCUSSION

Research Development of discovery learning-based content learning systems on the material of the atomic structure and elemental periodic systems uses the ADDIE model, with the Implementation stage to see the practicality of the content learning system. At this stage, the action taken is a limited trial. The trial was conducted on December 11, 2020, in class X TKR of Public Vocational High School 1 Pantai Cermin with 33 students. This research was conducted in only one meeting, and in the last meeting, the teacher was given a questionnaire response from the teacher, while the students were given a questionnaire on the responses of the students.

The teacher response questionnaire aims to determine the success of learning. The aspects observed in the teacher response questionnaire are the aspects of guidance and information, e-learning materials, e-learning activities, e-learning evaluation, e-learning design and facilities, and pedagogical effects [30]. The results of the teacher response questionnaire using discovery learning-based content learning systems on the material of the atomic structure and the periodic system of elements are shown in Table 2.

Tabel 3. Teacher response questionnaire results

No	Aspect	Percentage of Practicality	category
1	Guidelines and Information	0,91	Very High
2	E-learning material	0,88	Very High
3	E-learning activities	0,89	Very High
4	E-learning evaluation	0,87	Very High
5	E-learning design and facilities	0,91	Very High
6	Pedagogical Effects	0,90	Very High
Average		0,89	Very High

Based on Table 2, the results of the teacher's questionnaire responses to discovery learning-based content learning systems on the atomic structure and periodic system of elements are in the very high category with an average value of 0.89. So, it can be concluded that the teacher's questionnaire response to discovery learning-based content learning systems on the atomic structure and periodic elemental system material is said to be practical.
Student response questionnaires aim to find out students' understanding. The aspects observed in the student response questionnaire were aspects of guidance and information, aspects of e-learning material, aspects of e-learning activities, aspects of design and e-learning facilities.

Table 4. Student response questionnaire results

No	Aspect	Percentage of Practicality	Category
1	Guidelines and Information	0,88	Very Practical
2	E-learning material	0,88	Very Practical
3	E-learning activities	0,88	Very Practical
4	E-learning design and facilities	0,89	Very Practical
Rata-rata		0,88	Very Practical

Based on Table 3, the results of the students' questionnaire responses to the discovery learning-based content learning system material atomic structure and the periodic system of elements are in the very high category with an average value of 0.88. So, it can be concluded that the student response questionnaire to content learning systems based on discovery learning material on atomic structure and the elemental periodic system is said to be practical.

As for the overall results of the content learning system practicality trial based on discovery learning material on atomic structure and elemental periodic systems in the teacher response questionnaire with an average of 0.89 categories very high. In the student response questionnaire, an average of 0.88 was obtained and the category was very high. The practical results of content learning systems based on discovery learning materials on atomic structure and the periodic system of elements can be seen in Figure 1 .

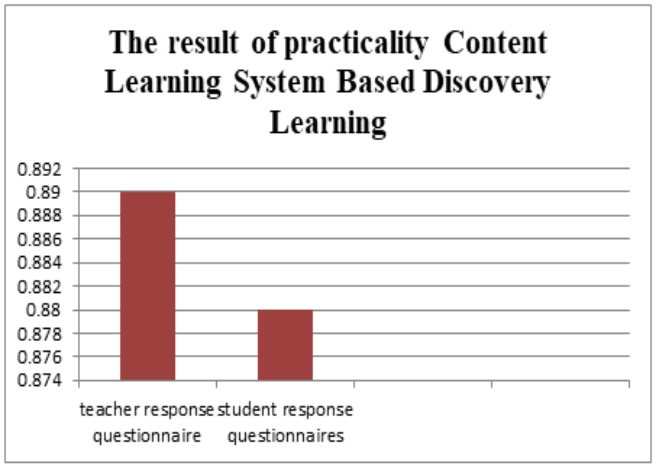


Figure 1.The overall results of the practicality of a discovery learning-based content learning system on the atomic structure and periodic system of elements

IV. CONCLUSION

Based on the results of the research process carried out to get the practicality of discovery learning-based content learning systems on the material of the atomic structure and elemental periodic systems using the ADDIE model (analysis, design, development, implementation, and evaluation), it produces a practical discovery learning-based content learning system obtained from two data, namely, first the questionnaire data on the response of the teacher with an average of 0.89 with a very high category, and the second for the questionnaire data on the response of students with an average of 0.88 with a very high category. Furthermore, the responses given by teachers and students to the assessment results in data from teacher response questionnaires, and student response questionnaires. In general, the teacher's response to the discovery learning-based content learning system that has been used in learning is that the teacher's response is very high and the students' responses are also very high. This means that the content learning system based on discovery learning on the material of the atomic structure and the periodic system of elements developed is practical.

REFERENCES

[1]. S. Rakic, N. Tasic, U. Marjanovic, S. Softic, E. Lüftenegger, and I. Turcin, "Student performance on an e-learning platform: Mixed method approach," *Int. J. Emerg. Technol. Learn.*, vol. 15, no. 2, pp. 187–203, 2020, doi: 10.3991/ijet.v15i02.11646.

[2]. C. Jittawiriyanukoon, "Proposed classification for elearning data analytics with MOA," vol. 9, no. 5, pp. 3569–3575, 2019, doi: 10.11591/ijece.v9i5.pp3569-3575.

[3]. T. Köhler, "A Web-Based Adaptive E-learning Application for Engineering Students : An Expert-Based Evaluation," pp. 60–71.

[4]. B. Beatty and C. Ulasewicz, "Faculty Perspectives on Moving from Blackboard to the Moodle Learning Management System," *TechTrends*, vol. 50, no. 4, pp. 36–45, 2006, doi: 10.1007/s11528-006-0036-y.

[5]. R. I. Alfina, "Analysis of E-learning implementation using Human Organization Technology approach (HOT) Fit Models," 2020, doi: 10.1088/1742-6596/1456/1/012058.

[6]. S. Chatterjee, D. Majumdar, and S. Misra, "Adoption of mobile applications for teaching-learning process in rural girls ' schools in India : an empirical study," 2020.

[7]. M. P. A. Murphy, "COVID-19 and emergency eLearning: Consequences of the securitization of higher education for post-pandemic pedagogy," *Contemp. Secur. Policy*, vol. 41, no. 3, pp. 492–505, 2020, doi: 10.1080/13523260.2020.1761749.

[8]. S. Shekapure and D. D. Patil, "Performance Based Adaptive Personalized eLearning System," no. 2, pp. 5988–5991, 2019, doi: 10.35940/ijrte.B3696.078219.

[9]. M. Ali, S. M. Khaled Hossain, and T. Ahmed, "Effectiveness of E-learning for university students: evidence from Bangladesh," *Asian J. Empir. Res.*, vol. 8, no. 10, pp. 352–360, 2018, doi: 10.18488/journal.1007/2018.8.10/1007.10.352.360.

[10]. D. Weaver, C. Spratt, and C. S. Nair, "Academic and student use of a learning management system: Implications for quality," *Australas. J. Educ. Technol.*, vol. 24, no. 1, pp. 30–41, 2008, doi: 10.14742/ajet.1228.

[11]. U. R. and A. S. G. Fatsyahrina Fitriastuti, "Multi-criteria decision making on succesfull of online learning using AHP Multi-criteria decision making on succesfull of online learning using AHP and regression," 2019, doi: 10.1088/1742-6596/1175/1/012071.
[12]. F. S. Anggriawan, "Pengembangan Learning Management System (Lms) Sebagai Media Pembelajaran Untuk Sekolah Menengah," *J. Kependidikan Penelit. Inov. Pembelajaran*, no. ellis, pp. 1–10, 2009.
[13]. A. T. Wibowo, I. Akhlis, and S. E. Nugroho, "Pengembangan LMS (Learning Management System) Berbasis Web untuk Mengukur Pemahaman Konsep dan Karakter Siswa," vol. 1, no. 2, pp. 127–137, 2014.
[14]. A. P. Lopes, "Learning management systems in higher education," no. July, pp. 5360–5365, 2014.
[15]. R. Zainul *et al.*, "Development of e-Learning Courses for Subjects about 'Learn and Learning' with Moodle-based for Prospective Teacher in Indonesia," *J. Phys. Conf. Ser.*, vol. 1594, no. 1, 2020, doi: 10.1088/1742-6596/1594/1/012023.
[16]. M. Adri *et al.*, "Development of Content Learning System in Professional Education Subjects for Educational Institutions in Indonesia," *J. Phys. Conf. Ser.*, vol. 1594, no. 1, 2020, doi: 10.1088/1742-6596/1594/1/012022.
[17]. R. Zainul and M. Adri, "Development of Moodle-based e-Learning Courses for Educational Platform for Prospective Educational Personel in Indonesia."
[18]. N. Wahyuningtyas and R. Zainul, "Development of Moodle-based Content Learning System in MKDK Student Development Subjects at LPTK in Indonesia."
[19]. J. E. B. Neil D. Jespersen, *Chemistry The Molecular Nature of Matter*. St. John's University, New York, 2012.
[20]. H. Munandar and Jofrishal, "Analisis Pelaksanaan Pembelajaran Kimia di Kelas Homogen," *Lantanida J.*, vol. 4, no. 1, pp. 98–110, 2016.
[21]. dan S. A. T. Yun Ismi Wulandari, Sunarto, "Implementasi Model Discovery Learning Dengan Pendekatan Saintifik Untuk Meningkatkan Kemampuan Berpikir Kritis Dan Hasil Belajar Siswa Mata Pelajaran Ekonomi Kelas XI IIS I SMA Negeri 6 Surakarta Tahun Pelajaran 2014/2015," *Nhk技研*, vol. 151, pp. 10–17, 2015.
[22]. E. S. Widyastuti, "Penerapan model pembelajaran discovery learning pada materi konsep ilmu ekonomi," pp. 33–40, 2014.
[23]. S. Prasetyana, Septina Dwi and Maridi, "Pengembangan Model Pembelajaran Discovery Learning Yang Diintegrasikan Dengan Group Investigation Pada Materi Protista Kelas X SMA NEGERI," vol. 4, no. 2, pp. 135–148, 2015.
[24]. A. I. Nichen Irma Cintia, Firosalia Kristin, "Penerapan Model Pembelajaran Discovery Learning Untuk Meningkatkan Kemampuan Berpikir Kreatif," vol. 32, no. 1, pp. 69–77, 2018.
[25]. R. Chang and J. Overby, *General Chemistry- The essential concepts*, vol. 6, no. 5. Americas, New York, 2012.
[26]. S. Siyoto and A. Sodik, "Dasar Metodologi Penelitian." Karanganyar : Literasi Media, pp. 1–132, 2015.
[27]. E. Mulyatiningsih, "Metode Penelitian Terapan Bidang Pendidikan," p. 183, 2011.
[28]. S. & P. A. W. Boslaugh, *Statistics in a Nutshell, a desktop quick reference.*, vol. 26, no. 1. 2009.
[29]. Riduwan, *Belajar Mudah Penelitian Untuk Guru-Karyawan dan Peneliti Pemula*. Bandung : Alfabeta, 2010.
[30]. L. Idrus, "Evaluasi Dalam Proses Pembelajaran," *Eval. Dalam Proses Pembelajaran*, vol. 9, no. 2, pp. 920–935, 2019.