

Improving the Process and Student Learning Outcomes of The Reaction Rate Material with Discovery Learning Model Assisted by Virtual Laboratory

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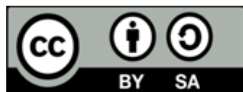
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ABSTRAK

Masalah yang terjadi saat ini yaitu masih banyak siswa yang kesulitan dalam belajar kimia. Penelitian lain menyatakan bahwa pembelajaran yang berpusat pada guru membuat siswa pasif dalam belajar sehingga berdampak pada hasil belajar siswa yang rendah. Tujuan penelitian ini yaitu menganalisis model discovery learning berbantuan laboratorium virtual untuk pelajaran Kimia. Jenis penelitian ini adalah penelitian tindakan kelas sebanyak tiga siklus, setiap siklus satu pertemuan. Setiap pertemuan terdiri dari 4 tahap (perencanaan tindakan, pelaksanaan tindakan, pengamatan tindakan dan refleksi terhadap tindakan). Metode yang digunakan untuk mengumpulkan data yaitu observasi, wawancara, kuesioner, dan tes. Instrumen yang digunakan untuk mengumpulkan data yaitu kuesioner. Teknik yang digunakan untuk menganalisis data yaitu analisis deskriptif kualitatif dan kuantitatif. Hasil penelitian yaitu diperoleh aktivitas dosen siklus 1, siklus 2 dan siklus 3 berturut-turut 75 %, 81,25% dan 93,75%. Sedangkan aktivitas mahasiswa berturut-turut 65,6%, 81,25% dan 87,5%. Ketuntasan kelas siklus 1, siklus 2, dan siklus 3 adalah 55,8%, 73,5% dan 88,2%, rata-rata hasil belajar siklus 1, siklus 2 dan siklus 3 adalah 67,9%, 70,4% dan 88,2%. Dari penelitian yang telah dilakukan diperoleh kesimpulan terjadi peningkatan aktivitas dosen, aktivitas mahasiswa, presentase ketuntasan kelas dan rata-rata hasil belajar pada pembelajaran materi laju reaksi dengan model discovery learning berbantuan laboratorium virtual.

ABSTRACT

Today's problem is that many students still have difficulty learning chemistry. Other research states that teacher-centered learning makes students passive in learning, impacting low student learning outcomes. This study aims to analyze the discovery learning model assisted by a virtual laboratory for Chemistry lessons. This type of research is classroom action research with three cycles. Each cycle has one meeting. Each meeting consists of 4 stages, implementation of the action, observation, and reflection on the action. The method used to collect data is observation, interview, and test. The instrument used to collect data is the technique used to analyze the data, namely descriptive qualitative and quantitative analysis. The research results obtained are lecturer activities in cycle 1, cycle 2, and cycle 3. participated in 75%, 81.25%, and 93.75%. Meanwhile, student activities were 65.6%, 81.25% and 87.5%, respectively. Completeness class cycle 1, cycle 2, and cycle 3 were 55.8%, 73.5% and 88.2%, the average learning outcomes in cycle 1, cycle 2 and cycle 3 are 67.9%, 70.4% and 88.2%. From the research that has been done, it is found that there is an increase in lecturer activity, student activity, class completeness percentage, and average learning outcomes. For the reaction rate with the discovery model, try learning with the help of a virtual laboratory.

1. INTRODUCTION

The current development of science and technology aims to achieve national education goals. One of the efforts that need to be made is the existence of educational innovations in the form of media utilization so that students have a complete understanding (Fauyan, 2019; Gever et al., 2021; Gunawan et al., 2017; Supriyadi et al., 2020). Chemistry learning has theoretical and practical learning activities

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(Budiariawan, 2019; Herawati & Muhtadi, 2018). In addition to requiring a learning framework, a learning media is also needed to support chemistry learning (Raharjo et al., 2017; Sinaga, 2017). As a science branch, chemistry is closely related to practical activities in learning to provide a meaningful learning experience (Jayadinigrat, 2017; Lutfi, A. et al., 2021). Today's problem is that many students still have difficulty learning chemistry. Other research states that teacher-centered learning makes students passive in learning, and it has an impact on low student learning outcomes (Amaliyah & Nasrudin, 2019; Ferdian et al., 2018). In addition, many students still feel that learning chemistry is very difficult (Juniarni et al., 2019; Saselah et al., 2017). Based on the results of observations and interviews conducted at Jambi University, it was found that students had difficulties in learning. The analysis of student learning outcomes in basic chemistry courses in the last three years obtained student learning outcomes on low-grade completeness class materials of about 65% with a KKM (Minimum Completeness Criteria) of 70. So far, the learning methods used by lecturers are lecture and question and answer methods. It causes students to get bored in learning, especially on the reaction rate material. The reaction rate material is one of the materials from the Basic Chemistry course, which studies the concept of reaction rate. These factors affect the reaction rate and the determination of the reaction order. In the learning objectives, it is said that the mastery of concepts by students is through experiments/practicums. Learning in the field of chemistry studies is a family of science. Its implementation in the field is expected to be based on experiments both directly and virtually (Harling, 2021; Lubis & Ikhsan, 2015; Rorita et al., 2018). Practicum is needed to realize the demands of the reaction rate learning objectives. The practicum topic is the factors that affect the reaction rate and the determination of the reaction order. On the other hand, the practicum implementation often experiences obstacles and limitations of tools and materials. There are several problems regarding the obstacles to direct experimentation, namely: inadequate equipment and chemicals, no laboratory, no laboratory assistant, the experiment is considered as something dangerous so that in its implementation it requires preparation and experience in the laboratory (Dwiningsih et al., 2018b; Sanova, 2018). Furthermore, students' conceptual understanding will be better at molecular level representations that cannot be observed directly with adequate simulation and visualization (Chiu et al., 2015; Herga, 2016). To realize the expected "practical skills," the role of ICT as a tool in learning, especially to develop the creativity of chemistry lecturers, innovation in learning, encourage students to be interested in chemistry, and bring abstract concepts into the real world to make them more realistic, communicative and innovative in the learning process. The integration of ICT in learning can create an effective learning climate for slow students, but it can also spur learning effectiveness for faster students (Chang et al., 2021; Jannah et al., 2020; Unwin, 2019).

It is evidenced by the availability of various learning media based on knowledge construction (Hapsari & Pamungkas, 2019; Rahmani & Widayarsi, 2018). The role of the learning media as cognitive aids is effective, efficient, and practical in supporting learning activities in the classroom and as a learning resource for students (Ambarwati, 2019; Khairani et al., 2019; Setyaningsih et al., 2018). One of the learning media in question is a virtual laboratory. The virtual laboratory is a series of laboratory learning innovations in software. (Dewa et al., 2020; Khairudin et al., 2019b). The software can be developed to be used flexibly and effectively on Android phones (Hermansyah et al., 2017; Rina Mirdayanti & Murni, 2017). The use of android phones can make it easier for students to learn before carrying out practicum. In practical activities, virtual laboratories provide a form offering in the form of more educational applications, computer/mobile-assisted physical and chemical simulations, and copies of natural phenomena and experimental conditions (Dwiningsih et al., 2018a; Irfan Yusuf et al., 2018). Previous research findings also state that virtual laboratories can complement live learning where students can study independently and online (Ristina et al., 2020; Irfan Yusuf et al., 2018). Other research also states that virtual laboratories can make it easier for students to study anywhere (Dewa et al., 2020; Khairudin et al., 2019b). There is no study on the virtual laboratory-assisted discovery learning model for Chemistry lessons. In addition, Virtual Laboratories are also relatively easier and cheaper than conventional laboratories and can reach many people in many places. This study aims to analyze the virtual laboratory-assisted discovery learning model for Chemistry lessons. It is hoped that the application of the discovery learning model assisted by a virtual laboratory can facilitate students learning.

2. METHODS

This type of research is classroom action research with three cycles. Each cycle is one meeting (150 minutes) (Salfera, 2017). Each meeting consists of four stages (action planning, action implementation, observation of actions, and reflection on actions). Several observers observed the lecturers' and students' activities during the action. At the end of the cycle, an evaluation was held. The research results obtained the activities of lecturers in the first cycle, second cycle, and third cycle. The

research begins by analyzing students' learning difficulties in the reaction rate material. Next, plan to overcome these student difficulties by making RPS (Semester Learning Plan) the first cycle. The methods used to collect data are observation, interviews, questionnaires, and tests used to collect data, namely a questionnaire. The technique used to analyze the data is descriptive qualitative, and quantitative analysis.

3. RESULTS AND DICCUSSION

Results

Data analysis of student learning difficulties is needed to plan further learning (learning improvement). Students' learning difficulties were revealed by interviewing ten students who had studied the reaction rate material. Students' results of interviews stated that reaction rates are difficult to study because they are very abstract and require practical work. In addition, students feel not interested in this material because they feel it is unnecessary. Students study individually and lack opportunities to ask questions and express their opinions. Based on the students' learning difficulties, learning is determined using the Discovery Learning model assisted by the Virtual Laboratory. Next, a Semester Lesson Plan is made. The Semester Lesson Plans designed are validated by senior lecturers who are experienced in learning basic chemistry. Validation is done by submitting 25 statements with a minimum score of 25 and a maximum of 125 and open comments. The first validation results obtained a score of 85 or 68%, and opinions or suggestions, concluding that they are not feasible to use. Furthermore, improvements are made based on the validator's suggestions and submitted to the validator for re-validation. The results of the second validation score were 115 or 92%, and there are no suggestions and conclusions that are suitable for use. The percentage of model implementation by lecturers is presented in [Figure 1](#).

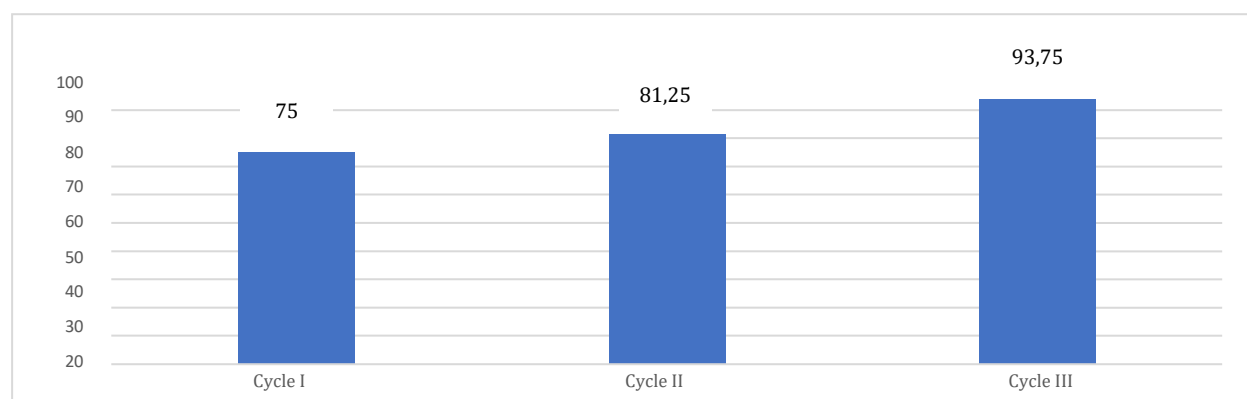


Figure 1. Percentage of model implementation by lecturers

Lecturer activities in teaching in each cycle were observed, and observers made observations based on the lecturer activity observation sheet format. The lecturer activity observation sheet consists of 16 items, the minimum score of each item is 1, and the maximum is 4. Observations are emphasized on implementing the applied model (Discovery Learning) and the use of virtual laboratory media. The results of the first cycle of observations are still many components of the model, and the media have not been appropriately implemented, namely a score of 48 or 75%. Weaknesses in the first cycle were corrected in the second cycle, increasing the second cycle's score to 52 or 81.25%. The observed components that were still not optimal in the second cycle were corrected in the third cycle. The result was that the lecturers' score for implementing the model was 60 or 93.75%. The percentage of model implementation by students is presented in [Figure 2](#).

The implementation of the model by students is strongly influenced by the implementation of the model by the lecturer. In the first cycle, students were confused because they had never studied using the Discovery Learning model so far. While the use of laboratory media. Virtual make students enthusiastic and excited. The number of items implemented by students is 16, with a minimum score of 16 and a maximum of 64. In the first cycle, students' average score for implementing the model is 42 or 65.6%, in line with the improvement of lecturer activities and student activities in the second and third cycles. In the second and third cycles, student activities were 52 or 81.25%, 56 or 87.5%. The percentage of the class passing for each cycle is presented in [Figure 3](#).

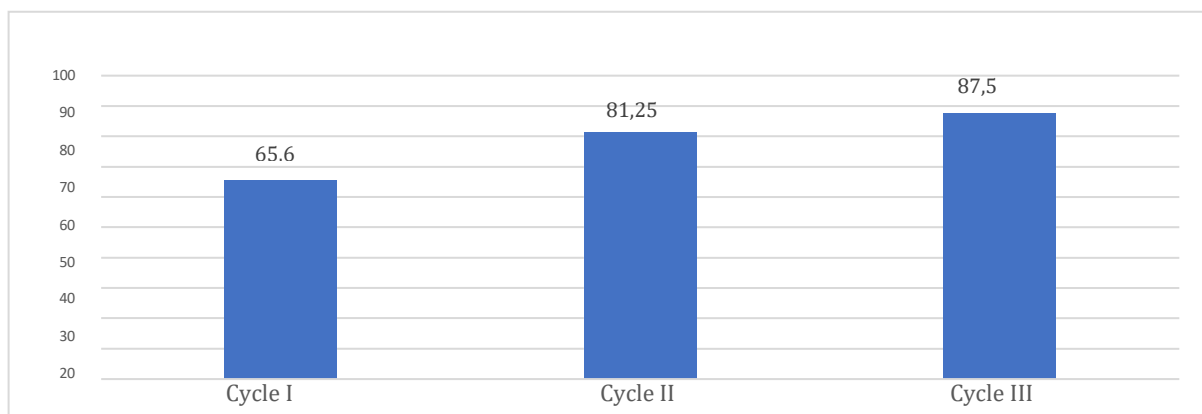


Figure 2. Percentage of model implementation by students

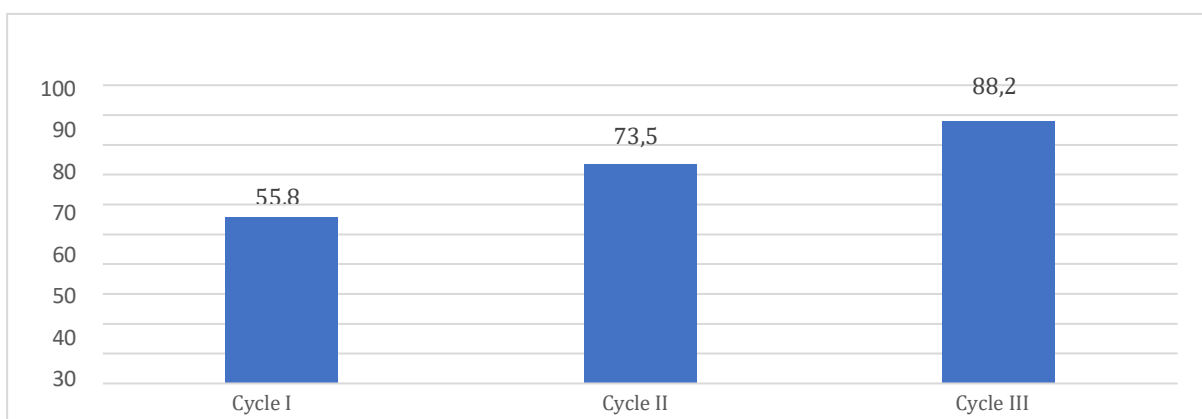


Figure 3. Percentage of class completeness in each cycle

Evaluation of student learning outcomes is carried out at the end of the cycle. The questions used are categorized as high-level thinking. If it is related to Bloom's taxonomy, the cognitive domains are C4-C6. The questions used are in the form of essay questions with three questions per cycle with a maximum score of 100. Thus, it can be concluded that the Discovery Learning model can improve student learning outcomes. This increase is supported by using a Virtual Laboratory as a substitute for a real practicum which is not possible due to the abstraction of the material.

Discussion

The Discovery Learning learning model assisted by a virtual laboratory can improve student learning outcomes. The Discovery Learning learning model makes it easier for students to understand chemistry learning materials. The discovery learning model requires students to find their way, and educators are only tasked with guiding and giving instructions. In discovery, students have the opportunity to be actively involved in learning. It causes students to be fully involved in activities such as discussing, reading and trying independently (Lidiana et al., 2018; Patandung, 2017; Rahayu et al., 2019; Sunismi, 2015). Discovery Learning is a model that can develop an active way of learning by discovering and investigating independently so that students will not easily forget it (Jalil, 2016; Mulyanto et al., 2020; Putri et al., 2019). By learning discovery through Discovery Learning, students can also learn to think analytically and try to solve their problems (Mayub et al., 2020; Rahmayani, 2019; Trianawati, 2019). In addition, the use of virtual laboratories can also help students in learning.

Virtual laboratories can gain conceptual knowledge and develop science process skills (Khairudin et al., 2019a; Manikowati & Iskandar, 2018). The virtual laboratory is created as an additional medium to develop skills in conducting analytical experiments and develop the ability to interpret experimental results, especially during pre-lab lectures (Dwiningsih et al., 2018b; I. Yusuf & Widyaningsih, 2020). Some of the benefits of using a virtual laboratory are that it allows students to receive reflections more quickly and correct misconceptions about the concepts being studied (Rizal et al., 2018; Sari et al., 2017). Practical activities in traditional laboratories that are expensive, complicated, and dangerous can be carried out safely and inexpensively in virtual laboratory activities. Learning activities with the Discovery Learning model assisted by a virtual laboratory make it easier for students to learn independently. The findings of

previous studies also state that the Discovery Learning model can help students learn (Anugraheni et al., 2018; Edeltrudis, 2018; Ladjar et al., 2018). Other research findings also state that the Discovery Learning model can improve student learning outcomes (Lidiana et al., 2018; Rahayu et al., 2019; Sunismi, 2015). Other research also states that virtual laboratories can complement live learning (Ristina et al., 2020; Irfan Yusuf et al., 2018). Other research also states that virtual laboratories can also help students in self-study (Dewa et al., 2020; Dwiningsih et al., 2018a; Hermansyah et al., 2017). Learning activities with the Discovery Learning model assisted by a virtual laboratory make learning easier for students. The Discovery Learning model assisted by a virtual laboratory can be used by lecturers in learning chemistry to make it easier for students to understand the learning material.

4. CONCLUSION

From the implementation of the research, it can be concluded that the Discovery Learning learning model assisted by a virtual laboratory can improve student learning outcomes on the reaction rate material. The reflection of lecturer activities in applying the Discovery Learning model increased from the first cycle to the second cycle and student activities.

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