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# Comparison between iSpring Suites-supported PBL and PjBL Model in Improving Students Understanding of Electrolyte and Non-Electrolyte Solution

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**Abstract:** This study aimed to determine whether there are significant differences in learning outcomes in the cognitive, affective, and psychomotor aspects of students who are taught with the Problem Based Learning and Project Based Learning models assisted by iSpring media on electrolyte and non-electrolyte solution materials. This research method is a quasi-experiment with a two-class pretest-posttest research design. Sampling was carried out using purposive sampling technique, and class X PMIPA 3 was selected as the experimental class I which was taught using the Problem Based Learning model assisted by iSpring media and X PMIPA 4 as the experimental class II which was taught by the Project Based Learning model assisted by iSpring media. The instruments used were tests in the form of pretest posttest sheets and non-tests in the form of assessment sheets on the affective and psychomotor aspects of students. Based on the results of the study, the average cognitive aspect learning outcomes were 83.71 in the experimental class I and 80.57 in the experimental class II. The average affective learning outcomes were 55.25 in the experimental class I and 55.05 in the experimental class II. The average learning outcomes of the psychomotor aspects were 78.57 in the experimental class I and 75.02 in the experimental class II. Therefore, it can be concluded that there is a significant difference in learning outcomes in the cognitive and psychomotor aspects of the two experimental classes, while in the affective aspect there is no significant difference.

**Keywords:** problem based learning, project based learning, iSpring, chemistry learning outcomes.

***Abstrak:*** *Penelitian ini bertujuan untuk mengetahui ada tidaknya perbedaan yang signifikan hasil belajar pada aspek kognitif, afektif, dan psikomotorik siswa yang dibelajarkan dengan model pembelajaran Problem Based Learning dan Project Based Learning berbantuan media I-spring pada materi larutan elektrolit dan non elektrolit. Metode penelitian ini adalah quasi experiment dengan desain penelitian two group pretest-posttest design. Pengambilan sampel dilakukan dengan teknik purposive sampling, dan terpilih kelas X PMIPA 3 sebagai kelas eksperimen I yang dibelajarkan dengan model Problem Based Learning berbantuan media iSpring dan X PMIPA 4 sebagai kelas eksperimen II yang dibelajarkan dengan model Project Based Learning berbantuan media iSpring. Instrumen yang digunakan yaitu tes berupa lembar pretest posttest dan non tes berupa lembar penilaian terhadap aspek afektif dan psikomotorik siswa. Berdasarkan hasil penelitian diperoleh rata-rata hasil belajar aspek kognitif yaitu 83,71 pada kelas eksperimen I dan 80,57 pada kelas eksperimen II. Rata-rata hasil belajar aspek afektif yaitu 55,25 pada kelas eksperimen I dan 55,05 pada kelas eksperimen II. Rata-rata hasil belajar aspek psokomotorik yaitu 78,57 pada kelas eksperimen I dan 75,02 pada kelas eksperimen II. Maka dapat disimpulkan bahwa hasil belajar pada aspek kognitif dan psikomotorik terdapat perbedaan yang signifikan pada kedua kelas eksperimen, sedangkan pada aspek afektif tidak terdapat perbedaan yang siginifikan.*

***Kata kunci:*** *model pembelajaran berbasis masalah, model pembelajaran berbasis proyek, iSpring, hasil belajar kimia.*

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## ▪ INTRODUCTION

Curriculum 2013 is a curriculum that emphasizes understanding, skills, and character education. Curriculum 2013 applies a more scientific approach that refers to the discovery of basic concepts that underlie the application of learning models by instilling scientific attitudes in students that touch three domains, namely attitudes, knowledge and skills. Good learning can be achieved through the teaching and learning process in the classroom. This learning activity determines the success in achieving educational goals, namely changing students so that they can have knowledge, skills, and attitudes of students as a form of behavior change as a result of learning (Arikunto, 2018). One of the chemistry subjects taught in high school is electrolyte and non-electrolyte solution material. Electrolyte and non-electrolyte solutions are subject matter with concepts that must be understood and mastered. This material actually will not be an obstacle or difficulty for students if the model used by the teacher is in accordance with the material provided (Sholihah, et al, 2019).

A solution is defined as a homogeneous mixture of two or more substances. An electrolyte solution is a solution that can cause a lamp to light up or gas bubbles around an electrode. This solution is also a solution that can conduct electric current. Non-electrolyte solutions are solutions that cannot conduct electric current. This solution is characterized by no lights and no gas bubbles. This solution cannot conduct electric current because there are no ions that move freely in the solution (Khamidinal et al., 2009). The ability to conduct electric current is not only owned by ionic compounds. Some covalent compounds are also capable of conducting electric current. The ability of a solution to conduct electricity can be tested with an electrolyte test kit.

Based on the results of interviews at SMA Negeri 1 Andam Dewi in class X PMIPA, it shows that the learning process at the school is still teacher-centered. In addition, varied learning models and media have not been applied, where teachers tend to just explain the material through the textbooks used. This has an impact on low student learning outcomes, seen from the average student test results with a percentage of 60%. Therefore, to improve student learning outcomes, it is necessary to use learning models and media that can help students to be more focused and active in learning. Learning activities are said to be successful if these activities are effective which can be measured by student learning outcomes (Trisnowati, et al, 2020).

Learning outcomes are the final assessment of the process and recognition that has been done repeatedly. And will be stored for a long period of time or even will not be lost forever because learning outcomes participate in shaping individuals who always want to achieve better results so that they will change their way of thinking and produce better work behavior. Learning outcomes consist of three domains: cognitive, affective, and psychomotor. Factors that influence learning are internal factors and external factors. Internal factors include body, talent, motivation, emotions, and attention. While external factors include the family environment, school environment, and community environment (Widodo & Dian, 2018).

According to Joyce & Weil (1980), the learning model has characteristics, namely, has a specific educational mission; can be used as a guide for improving teaching and learning activities; has parts of the model in implementation; and has an impact as a result of the application of the learning model, which includes measurable learning outcomes and long-term learning outcomes. The final result or long-term result of the learning

process is the high ability of students to be able to learn more easily and more effectively in the future. Therefore, the learning process does not only have descriptive meaning, but also prospective and future-oriented meaning. The learning model that can improve student learning outcomes is the Problem Based Learning learning model. Problem Based Learning is an approach that gives learners new knowledge to solve a problem, so this approach is a participatory learning approach that can help teachers create a fun learning environment. Problem Based Learning can also be referred to as collaborative learning, combining the potential between teachers and students (Syamsidah and Hamidah, 2018).

In addition, the Project Based Learning model can also improve student learning outcomes. This model has advantages that lie in its application which involves students to be active in working on a project that is useful for solving community or environmental problems. Project Based learning in the concept of Giilbahar & Tinmaz (2006) is a model that can organize projects in learning. Project-based learning provides opportunities for a student-centered, more collaborative learning system, students are actively involved in completing projects independently and working with teams and integrating real and practical problems. Project-Based Learning according to Umamah & Andi (2015) as a project-based learning which is an innovative learning approach strongly emphasizes contextual learning through complex activities.

The use of media can also help improve student learning outcomes. One of the media that can be used is iSpring media (Vikulova, Makarova, & Gerasimova, 2018). Many researchers used iSpring suites in science learning (Minnakhmitova, Ibashova, & Belesova, 2023; Rakhimovich, 2022; Kirillov, 2021; Allambergenova, Kunnazarov, & Kazbekova, 2020; Lopes et al., 2020; Nurwijayanti & Fitriana, 2019; Young, McLaren, & Maden, 2017). According to Juraev (2019) iSpring is software that has high quality among other tools that are often used in the world of education. Meanwhile, according to Ramadhani, Fatmawati & Oktarika (2019) explained that iSpring can be developed to create interactive learning media and can load image content, animation, audio, video, and others. The advantages possessed by iSpring are that the iSpring program is equipped with various types of interactive questions, students can easily repeat material that students have not understood, provides clear instructions for use, the display of images, photos, animations and videos makes it easier for students to understand concepts, and the appearance and opening animation on learning media attracts students' attention to learning.

Based on this description, this study aims to determine whether there is a significant difference in learning outcomes in the cognitive, effective, and psychomotor aspects of students using the Problem Based Learning model compared to using the Project Based Learning model with iSpring media assistance on electrolyte and non-electrolyte solution materials.

## ▪ METHOD

This research was conducted at SMA Negeri 1 Andam Dewi which is located at Jalan Rina Bolak, Andam Dewi District, Central Tapanuli Regency, North Sumatra. The population in this study were all students of class X PMIPA SMA Negeri 1 Andam Dewi with a total of 4 classes, each class consisting of 35 students. The samples in this study were two classes, namely X PMIPA 3 and X PMIPA 4 using purposive sampling technique. The method used in this research is quasi-experiment. The design used in this

research is two class pretest - posttest design. Research using this design because it uses two experimental class: experimental class I and experimental class II. The procedure in this study is organized into three steps, namely: 1) Preparation Stage, including: observation, formulating problems, preparing lesson plans, compiling and validating instruments and learning media, conducting trials and analyzing instruments; 2) The Implementation Stage, including: determining the sample, distributing pretest questions, implementing learning, distributing posttest questions; 3) The final Stage, including: processing or analysing data and making conclusions.

The instruments used are pretest and posttest questions totalling 20 and non-tests non-tests in the form of student affective and psychomotor aspects assessment sheets. Before the instrument was used, the researchers first prepared 40 grids. The grids were validated to expert lecturers and then tested on students. After the test was carried out, the validity, reliability, level of complexity and differentiating power have been tested. Data analysis techniques include prerequisite analysis consisting of normality test using Chi squared test, homogeneity test and hypothesis testing using two-party t test.

## ▪ RESULT AND DISSCUSSION

Based on the results of the analysis of validity, reliability, difficulty level, and differentiation of test questions, it was found that of the 40 questions that had been tested on students, 27 test questions were said to be valid and 13 other questions were invalid. Test reliability test results using the formula Kuder Richardson (KR-20) obtained that the overall test reliability was 0,777, where rtab = 0,329, because $r_{calc} > r_{table}$ then the question is declared reliable with a very high reliability category. The results of the test difficulty level using the difficulty level formula and the help of the test difficulty level calculation table show that there are 16 difficult category questions, 16 medium category questions, and 8 easy category questions. The results of the test difference test in this study show that there are 17 questions with a poor difference power category and 23 questions with a good difference power category. From the data that has been obtained, 20 questions are obtained that have met the standards from the results of the four tests.

Before the two experimental classes were given treatment, an initial test was given to determine the initial ability of each student. Furthermore, different learning is carried out with the help of the same media, namely iSpring, which in experimental class I is taught with the Problem Based Learning learning model and experimental class II with the Project Based Learning learning model. At the end of the learning process, both experimental class I and experimental class II were given a final test to determine student learning outcomes. After the data from the pretest and posttest results of the two experimental classes were collected, the average pretest and posttest were calculated. Then the normality test, homogeneity test, and hypothesis test were carried out to obtain conclusions.

Data on student learning outcomes in cognitive aspects were obtained from pretest and posttest results. Data on student affective learning outcomes were obtained when assessing the two experimental classes during the learning process. Data on students' affective learning outcomes were obtained when assessing the two experimental classes during practicum activities. The average value of learning outcomes in cognitive aspects was 83.71 in experimental class I and 80.57 in experimental class II. The average learning outcomes in affective aspects amounted to 55.25 in experimental class I and 55.02 in

experiment II. In the psychomotor aspect, the average learning outcomes were 78.57 in experimental class I and 75.02 in experimental class II. The average value of student learning outcomes in the three aspects is depicted in the following diagram.

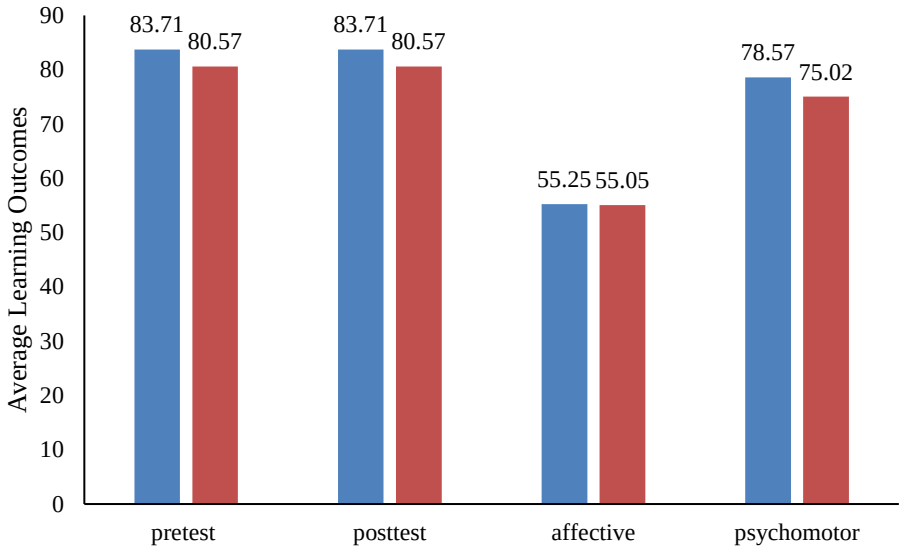


**Figure 1.** Diagram of student learning outcomes in cognitive, affective, and psychomotor aspects

The normality test is carried out to determine whether the data is normally distributed or not. The results of the calculation of the normality of student learning outcomes data on cognitive, affective, and psychomotor aspects can be seen in the following table:

**Table 1.** Normality test of cognitive, affective and psychomotor learning outcomes data

| Group | Data | $X^2_{hit}$ | $X^2_{tab}$ | $\alpha$ | Description |
|---|---|---|---|---|---|
| Experiment I | Pretest | 8.87 | 11.07 | 0.05 | Normal |
| | Posttest | 8.01 | | | |
| | Affective | 9.54 | | | |
| | Psychomotor | 10.69 | | | |
| Experiment II | Pretest | 7.35 | | | |
| | Posttest | 9.32 | | | |
| | Affective | 7.34 | | | |
| | Psychomotor | 9.34 | | | |

X2 table at α= 0,05 with db = 5 is 11.07. On cognitive aspects, because X2hit < X2 tab then pretest and posttest scores experimental class I and experimental class II are normally distributed. On affective aspects, because X2hit < X2 tab then the affective learning outcomes of experimental class I and experimental class II are normally distributed. On psychomotor aspects, because X2hitung < X2 tabel then the psychomotor learning outcomes of experimental class I and experimental class II are normally distributed.

Homogeneity test is conducted to determine whether the data is homogeneous or not. The homogeneity test of learning outcomes is done by founding Fhit, by comparing the variance of the largest data with the variance of the smallest data. The results of the calculation of the normality of student learning outcomes data on cognitive, affective, and psychomotor aspects can be seen in the following table:

**Table 2.** Homogeneity test of cognitive affective and psychomotor learning outcomes data

| Group | Data | Varians | $F_{hit}$ | $F_{tab}$ | Description |
|---|---|---|---|---|---|
| Experiment I | Pretest | 71.83 | 1.33 | 1.77 | Homogeneous |
| | Posttest | 39.06 | 1.22 | | |
| | Affective | 82.70 | 1.28 | | |
| | psychomotor | 62.13 | 1.52 | | |
| Experiment II | Pretest | 96.20 | 1.33 | | |
| | Posttest | 33.95 | 1.22 | | |
| | Affective | 106.65 | 1.28 | | |
| | psychomotor | 40.71 | 1.52 | | |

$F_{table}$ ($\alpha$= 0.05) with db =(35-1)(35-1) is 1.77. On cognitive aspects, because $F_{calc} < F_{table}$ then the pretest and posttest data in Experiment I and Experiment II classes are homogeneous. On affective aspects, because $F_{calc} < F_{table}$ then the data on affective learning outcomes of students in Experiment I and Experiment II classes are homogeneous. On psychomotor aspects, because $F_{calc} < F_{table}$ then the data on student psychomotor learning outcomes in Experiment I and Experiment II classes are homogeneous.

Hypothesis testing is done to determine whether there are differences in student learning outcomes in experimental classes I and Experiment II. Hypothesis test results student learning in cognitive, affective, and psychomotor aspects on the psychomotor aspects can be seen in the following:

**Table 3.** Hypothesis test of cognitive affective and psychomotor learning outcomes data

| Class | Data | Varians | $F_{hit}$ | $F_{tab}$ | Description |
|---|---|---|---|---|---|
| Eksperimen I | Cognitive | 39.06 | 2.17 | 1.99 | Ha retrieved, Ho rejected |
| | Affective | 82.70 | 0.99 | | |
| | Psychomotor | 62.13 | 2.07 | | |
| Eksperimen II | Cognitive | 33.95 | 2.17 | | |
| | Affective | 106.65 | 0.99 | | |
| | Psychomotor | 40.71 | 2.07 | | |

On cognitive aspects, the results is t hit > t tabel (2,17 >1,99), then Ha is accepted, Ho is rejected. Thus it can be concluded that there are differences in the learning outcomes of students taught with problem-based learning and project-based learning models assisted by iSpring on the material of electrolyte and non-electrolyte solutions. On affective aspects, it can be concluded that there is no difference in the learning outcomes of students taught with Problem Based Learning and Project Based Learning models assisted by iSpring on the material of electrolyte and non-electrolyte solutions. On

psychomotor aspects, the results is $t_{calc} > t_{table}$ (2.07 >1.99), then Ha is accepted, Ho is rejected. Thus, it can be concluded that there are differences in the learning outcomes of students taught with Problem Based Learning and Project Based Learning models assisted by iSpring on electrolyte and non-electrolyte solution materials.

In this study, learning was carried out based on the Problem Based Learning and Project Based Learning models. Problem Based Learning has phases that must be taken, namely first giving orientation about the problem to students, which is related to electrolyte and non-electrolyte solution material according to the research material. Second, organizing students, namely dividing students into several groups. Researchers formed students into six groups, each group consisting of 6 people, then directed students to pay attention to the explanation given and asked students to discuss with their respective groups. Third, guiding students' investigations in completing the learner worksheets. During the discussion activities, researchers approached each group and asked about the difficulties experienced. Fourth, developing and presenting the results of the work, namely instructing the group to present the results of the discussion in front of the class. The researcher appointed several groups to present the results of their discussions and conduct question and answer activities. And the fifth, analyzing and evaluating the problem-solving process, in which the researcher asks students to conclude the learning that has been given. After that, the researcher reviewed the results of several groups' presentations and summarized the learning activities that had been carried out. The application of this learning model is able to improve student learning outcomes which can be seen from the final average score of student learning. This is in accordance with previous research conducted by Bulotio et al (2020) which states that there is an effect of using the Problem Based Learning model on electrolyte and non-electrolyte solution material on student scores, because the application of this model is able to make students more focused and excited because the learning is associated with problems that occur in everyday life.

Project based learning also consists of six phases that must be taken, namely fundamental questions about the material taught, namely electrolyte and non-electrolyte solutions; designing product planning such as guiding students in making electrolyte test kits; following the manufacturing schedule, which is carried out at each meeting; monitoring the activeness and development of the project where the researcher assesses students during learning and helps each group in the process of making products; testing the results by guiding students to make presentations in front of the class and conducting questions and answers; and the last is evaluating the learning experience by explaining and summarizing the learning that has been done. By applying this learning model can improve student learning outcomes in accordance with the average learning outcomes from both cognitive, affective, and psychomotor aspects. Based on previous research conducted by Rahman et al. (2019) which states that the use of the Project Based Learning model can increase student learning test results by 92.10 with a very high category.

**Figure 2.** Learning and practicum activities

In addition to the application of Problem Based Learning and Project Based Learning models, learning is assisted by the use of learning media, namely iSpring media. The existence of this media can improve student learning outcomes, which can be seen from the final results or comparison of student learning outcomes before and after the application of the media. This is in line with research conducted by Pooroe, et al (2020) obtained the results that it is able to make students achieve completeness and increase student learning outcomes calculated using the gain formula obtained by 0.68% including in the moderate category.

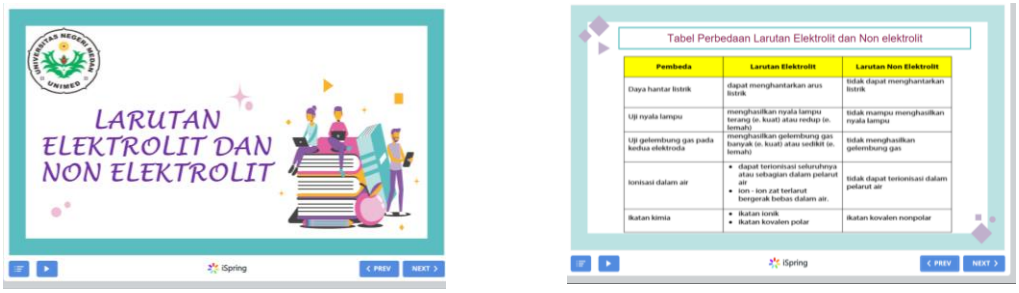


**Figure 3.** Screen capture of iSpring learning media

Based on the results of this study, it shows that students in experimental class I who were taught with the PBL learning model were much better at improving student learning outcomes than students in experimental class II who were taught PjBL. This is in line with the opinion of Musriadi (2014) which states that PBL model learning makes learning student-centered, so that it can develop students' skills in problem solving, improve students' critical thinking skills, develop cooperation, and student communication skills. As stated by Rahmawati (2015) problem-based learning allows students to realize the existence of problems in their lives because in this learning, the teacher presents problems that exist in real life. So that it can improve students' critical thinking in solving problems, as well as gain knowledge of new concepts.

## ▪ CONCLUSION

Based on the results of the research that has been done, it can be concluded that there are differences in student learning outcomes in cognitive and psychomotor aspects taught with PBL and PjBL models assisted by iSpring media on electrolyte and non-electrolyte solution materials. In the affective aspect, there is no difference in student learning outcomes taught with PBL and PjBL models assisted by iSpring media on

electrolyte and non-electrolyte solution materials. The average score on the cognitive aspect is 83.71 in PBL class and 80.57 in PjBL class. The average on the affective aspect is 55.25 in PBL class and 55.02 in PjBL class. And the average value obtained on the psychomotor aspect is 78.57 in the PBL class and 75.02 in the PjBL class.

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