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Application of the Problem-Based Learning Model to Improve Students' Understanding of Welding Defect Material

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ABSTRAK

The purpose of the study is to observe the *Problem-Based Learning* learning model; it is hoped that students, as prospective welding welders, can understand the types and forms of welding defects that arise to assess the quality of welding performed. This research was conducted on grade XI Las 2 students of SMKN 1 Udanawu using the classroom action research method (Classroom Action Research). The results of the research conducted obtained an increase in the average completeness results of students from the precycle, cycle I, and cycle II students of grade XI Las 2 SMKN 1 Udanawu, which initially only reached 30.2 in the precycle to 56.4 in cycle I and in cycle II to 81.3. This happens because, in practice-based learning, students only concentrate on practice and ignore theories related to welding defects. After Problem-*Based Learning is carried out,* students better understand the causes and effects of welding defects that arise. The factor that increases student understanding in cycles I and II is that learning is made in groups, so students are more active in identifying welding defects. In cycle II, students present the identification results so that students indirectly understand the material related to welding defects. From the increased learning outcomes, students can judge the welding quality performed.

ABSTRAK

Tujuan penelitian yaitu untuk mengamati dengan model pembelajaran Problem Based Learning diharapkan agar siswa sebagai calon welder pengelasan dapat memahami jenis dan bentuk cacat pengelasan yang timbul agar dapat menilai kualitas pengelasan yang dilakukan. Penelitian ini dilakukan pada siswa kelas XI Las 2 SMKN 1 Udanawu dengan menggunakan metode penelitian tindakan kelas (Classroom Action Research). Hasil dari penelitian yang dilakukan diperoleh peningkatan rata-rata hasil ketuntasan siswa dari prasiklus, siklus I, dan juga siklus II siswa kelas XI Las 2 SMKN 1 Udanawu yang awalnya hanya mencapai 30,2 pada prasiklus menjadi 56,4 pada siklus I dan pada siklus II menjadi 81,3. Hal ini terjadi karena dalam pembelajaran berbasis praktek siswa hanya terkonsentrasi pada praktek dan mengabaikan teori terkait cacat pengelasan. Setelah dilaksanakan pembelajaran Problem Based Learning siswa lebih memahami sebab dan akibat dari cacat

pengelasan yang timbul. Faktor yang meningkatakan pemahaman siswa pada siklus I dan II yaitu pembelajaran dibuat berkelompok sehingga siswa lebih aktif dalam mengidentifikasi cacat pengelasan. Pada siklus II, siswa memprentasikan hasil identifikasi sehingga secara tidak langsung siswa memahami materi terkait cacat pengelasan. Dari naiknya hasil belajar, siswa dapat menilai sendiri kualitas pengelasan yang dilakukan.

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INTRODUCTION

Amid today's tight industry competition, quality is an indicator for a company to continue to exist, survive, and even develop.[1]In other words, quality is a dead price; making a product that is not quality is equivalent to planning the destruction of a company sooner or later. The higher the quality of an item, the higher the customer satisfaction will increase sales and ultimately increase the company's profits.[2]

Improving the quality of a product is a company strategy to minimize the number of defects that occur. The decrease in the number of defects allows the company to reduce production costs, which impacts the level of company competition. Quality improvement must take time to get the expected results. For this reason, continuous improvement of product quality (continuous improvement) is very necessary for every company.[3]

Welding is an important process in the industrial world and is an inseparable part of industrial growth.[4] Welding is major in engineering and repairing metal production (Firdaus & Bukhari, 2020). Welding is the local

[1] Ritonga, A. S., & Purwaningsih, E. S. "Penerapan Metode Support Vector Machine (SVM) dalam Klasifikasi Kualitas Pengelasan SMAW (Shield Metal Arc Welding)." *Jurnal Ilmiah Edutic: Pendidikan dan Informatika*, *5*(1) (2018): 17-25.

[2] Merjani, A., & Kamil, I. "Penerapan Metode Seven Tools dan PDCA (Plan Do Check Action) untuk Mengurangi Cacat Pengelasan Pipa." *J. Profisiensi*, *9*(1) (2021): 124-131.

[3] Rohimudin, R., Dwiputra, G. A., & Supriyadi, S. "Analisis Defect pada Hasil Pengelasan Plate Konstruksi Baja dengan Metode Six Sigma." *Jurnal INTECH Teknik Industri Universitas Serang Raya*, *2*(1) (2016): 1-10.

[4] Yang, Lei, et al. "An Automatic Welding Defect Location Algorithm Based on Deep Learning." *Ndt & E International* 120 (2021): 102435.

joining between two or more metal parts by harnessing thermal energy.[5] The scope of use of material splicing techniques (welding) in construction is very wide, covering the fields of shipping, bridge making, steel frames, pressure vessels, channel pipes, rail vehicles, and so on. In addition, the welding process can also be used for repairs, for example, to fill holes in castings, thicken worn parts, replating, and other kinds of repairs.

Defects in welding are a condition where welding that has been done is not by predetermined standards.[6] According to Ervianto, welding defects occur due to errors caused by a welding process that appears during welding inspections.[7] Weld defects can arise from several factors. Factors that cause welding defects include welders, where the welder plays a role in welding results.[8] A skilled welder largely determines the least defects arising from the welding process. The welder is also responsible for the material to be welded. With a change in the angle of inclination of the tool and the condition of the material, defects may occur.[9] Another influential factor is the welding machine. Welding machines also influence the least defects arising from the welding process.[10] Excellent welding machines or in good condition will minimize the occurrence of welding defects carried out during the welding process.

At some stage, defects arising from the welding process results can affect the joint's quality.[11] In this case, the quality of a good welding joint is greatly influenced by the least defects that arise during the welding process. Defects arising from the wrong welding process or poor machine conditions usually

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[5] Pratama, R. Y., Basuki, M., & Pranatal, E., "Pengaruh Variasi Arus Pengelasan Smaw untuk Posisi Pengelasan 1g pada Material Baja Kapal SS 400 terhadap Cacat Pengelasan." *Jurnal Sumberdaya Bumi Berkelanjutan (SEMITAN) 2*(1) (2020): 203-209.

[6] Katon Muhammad, Fadhila Rifda Azka Syailendri, and Ayu Anggraeni Sibarani, "Analisis Cacat Produk Pada Proses Pengelasan Pipa Penstock (Studi Kasus: PT. XYZ)," *SPECTA Journal of Technology* 4, no. 3 (2020): 61–71.

[7] Abdul Aziz Khalilurrahman et al., "Analisis Defect Hasil Pengelasan Pada Suspensi Belakang Ertiga Di PT. XYZ," *Jurnal Teknik Mesin Dan Pembelajaran* 4, no. 2 (2021): 62–70.

[8] Hongquan Jiang et al., "Convolution Neural Network Model with Improved Pooling Strategy and Feature Selection for Weld Defect Recognition," *Welding in the World* 65 (2021): 731–44.

[9] Chen, H. B., Yan, K., Lin, T., Chen, S. B., Jiang, C. Y., & Zhao, Y., "The Investigation of Typical Welding Defects For 5456 Aluminum Alloy Friction Stir Welds." *Materials Science and Engineering: A*, *433* (2006): 64-69.

[10] Azwinur Azwinur et al., "Pengaruh Arus Terhadap Sifat Mekanik Aluminium Pada Pengelasan GTAW," in *Prosiding Seminar Nasional Politeknik Negeri Lhokseumawe*, vol. 4, 2020, 185–90.

[11] Baughurst, Leigh, and Grant Voznaks. "Welding Defects, Causes and Correction." *Australian Bulk Handling Review* (2009): 26-28.

result in welding results that do not stick to the workpiece.[12] In other conditions, the defects that arise also result in porous joints so that metal joints are not strong and easily broken if exposed to high loads. Porosity is formed from bubbles generated from the tip of the keyhole at low welding speeds or from the center of the keyhole at high laser power densities.[13] Porosity is one of the defects arising from incorrect welding results.[14] In other conditions, porosity defects result in porous joints so that metal joints are not strong and easily broken if exposed to high loads.

Vocational High School (SMK) is a formal secondary-level educational institution established to prepare students to have the ability to work in certain fields of work.[15] Vocational High Schools (SMK) are expected to produce graduates who can create jobs and produce competitive job seekers.[16] As preparation and providers of prospective skilled workers, vocational education institutions must effectively utilize their resources and resources of partnership networks with external parties.[17] The focus of learning in SMK needs to emphasize mastery of skills, knowledge, attitudes, and values needed by the industry.[18]

In education, especially at the vocational level, there are potential majors, namely the Department of Welding Engineering, where students must emphasize the basics of welding.[19] In addition, students must also be introduced to various kinds of welding defects arising from welder errors and

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[12] Fauzi Widyawati and Lino Marano, "Identifikasi Cacat Lasan Fcaw Pada Fondasi Mesin Kapal Menggunakan Metode Ultrasonic Testing," *Jurnal TAMBORA* 5, no. 2 (2021): 53–58.

[13] Katayama, Seiji, Yousuke Kawahito, and Masami Mizutani. "Elucidation of Laser Welding Phenomena and Factors Affecting Weld Penetration and Welding Defects." *Physics procedia* 5 (2010): 9-17.

[14] Hook, Jeffrey R. "An Introduction to Porosity." *Petrophysics-The SPWLA Journal of Formation Evaluation and Reservoir Description* 44.03 (2003).

[15] Romadin, Achmad, Didik Nuhadi, and Yoto Yoto. "Implementation of Work Based Learning on Welding Engineering Expertise Competency in The Manufacturing Industry." *Journal of Vocational Education Studies* 5.1 (2022): 16-31.

[16] Susilo, Ferry Cahyo, Widiyanti, and Isnandar. "Implementation of Welding Production Unit Learning Model for Students' Entrepreneurial Preparedness of Public Vocational High School." *Technology and Vocational: Journal of Technology, Vocational, and Its Teaching* 45.1 (2022): 11-18.

[17] Yoto and Marsono. "Implementation of Work-Based Learning at Teaching Factory in Vocational Education." *Technology and Vocational: Journal of Technology, Vocational, and Its Teaching* 43.2 (2020): 150-155.

[18] Achsani, Hamzah, Djoko Kustono, and Syarif Suhartadi. "Model Kelas Industri pada Mitsubishi School Program di Sekolah Menengah Kejuruan." *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan* 5.8 (2020): 1078-1085.

[19] Abdul Kadir Ahmad, "Pendidikan Life Skill Di Madrasah Aliyah: Studi Kasus MA Keterampilan Al Irsyad Gajah, Demak," *EDUKASI: Jurnal Penelitian Pendidikan Agama Dan Keagamaan* 20, no. 2 (2022): 150–67.

defects arising from poor welding machine conditions. But, in the field, many students from the welding department still need to understand the welding defects that arise during the welding process. The learning process that is only theory-based, which is directly given to students, still needs to improve in increasing students' understanding of the various defects in welding.[20] So that students cannot judge for themselves the quality of welding that has been done. Students only show welding results to teachers who teach without understanding what mistakes are made when welding, so there are defects in the welding results.[21]

Based on these problems, the Problem-Based Learning learning model is carried out. According to Rambe and Nurwakhidah (2023), the *Problem-Based Learning* learning model is a problem-based learning method where the problems that arise follow existing reality, and students must solve these problems with concepts related to problems given through the scientific method.[22] Another definition of the *Problem-Based Learning* learning model is a pattern used for guidelines for planning learning in the classroom that is arranged systematically to achieve certain learning goals. Learning that applies an interesting learning model can be used to improve the quality of learning.[23]Problem-based learning *is* widely regarded as a successful and innovative method for engineering education, according to De Graaf & Kolmos (2003). Problem-based *learning is an influential way of inquiry-based learning where students use authentic problems as contexts for in-depth inquiry into what they need and what to know.* [24]

The Problem-Based Learning *learning model* can increase students' curiosity so that it directly impacts students where they can understand and explore existing theories.[25] Problem-based learning is the most innovative

[20] Chih-Chao Chung et al., "Using an ISTEAM Project-Based Learning Model for Technology Senior High School Students: Design, Development, and Evaluation," *International Journal of Technology and Design Education*, 2020, 1–37.

[21] Aris Munandar and Riswan Dwi Djatmiko, "Pengembangan Job Sheet Praktik SMAW Posisi 3G Berbasis Welding Procedure Specification (WPS) SMK," *Jurnal Pendidikan Vokasional Teknik Mesin* 7, no. 1 (2019): 45–50.

[22] Posman Rambe and Nurwahidah Nurwahidah, "The Impact of Problem-Based Learning Learning Methods on the Development of Islamic Education Learning," *Journal of Insan Mulia Education* 1, No. 1 (2023): 25–30.

[23] Yuafian, Reza, and Suhandi Astuti. "Peningkatan Hasil Belajar Siswa Menggunakan Model Pembelajaran Problem Based Learning (PBL)." *JRPD (Jurnal Riset Pendidikan Dasar)* 3.1 (2020): 17-24.

[24] Akcay, Behiye. "Problem-Based Learning in Science Education." *Journal of Turkish Science Education* 6.1 (2009): 28-38.

[25] Yew, Elaine HJ, and Karen Goh. "Problem-Based Learning: An Overview of Its Process and Impact on Learning." *Health professions education* 2.2 (2016): 75-79.

instructional method ever seen in the history of education.[26] So, the purpose of applying the *Problem-based* learning model in this study is to increase students' understanding of the various defects in welding.

SMK Negeri 1 Udanawu is one of the large vocational education institutions in the Blitar Regency area. One of the potential majors with complete machine tools is the welding engineering department. Based on observations made by researchers, there is a problem in the welding engineering department at SMK Negeri 1 Udanawu. The problem at the research location is that students need to pay attention to theoretical learning, which impacts the welding process, and to welding defects that arise to improve the welding quality. Based on these problems, research conducted at the welding engineering department of SMK Negeri 1 Udanawu aims to increase understanding of welding defects so that students can assess the quality of welding carried out so that students can improve the results of welding performed. The [27]The applied problem-based *learning model* can significantly increase students' understanding of welding procedures.[28] In addition to increasing motivation, interest, and students' understanding of defects in welding, students are expected to be able to assess the quality of welding carried out so that students can improve welding results well.

METHOD

The research method used in this study is classroom action research (*Classroom Action Research*).[29] This type of classroom action research is reflective and collaborative research conducted to improve welding quality.

According to O'Brien (2001), action research is carried out when a group of people (students) identify the problem, and then the researcher (teacher) sets an action to overcome it. During the action, researchers observed changes in student behavior and the factors that caused the action

[26] Hung, Woei, David H. Jonassen, and Rude Liu. "Problem-Based Learning." *Handbook of research on educational communications and technology* 3.1 (2008): 485-506.

[27] Marfuah, Umi, et al. "Menurunkan Cacat Pengelasan Zinc Plate Steel pada Pengembangan Produk Tangki Bahan Bakar Sepeda Motor dengan Metode QCC." *Prosiding Seminar Nasional Ilmu Teknik Dan Aplikasi Industri Fakultas Teknik Universitas Lampung*. Vol. 5. 2022.

[28] Pasaribu, Unjur Panahatan. "Perbedaan Hasil Belajar Siswa Yang Diajar Dengan Strategi Problem Based Learning Dan Metode Konvensional Pada Kompetensi Dasar Pelaksanaan Prosedur Pengelasan Pada Siswa Kelas X Smk Swasta 1 Hkbp Sipoholon Tahun Ajaran 2012/2013." *Diss. UNIMED*, 2013.

[29] Radiansyah Radiansyah, Fathul Jannah, and Raihanah Sari, "Workshop Pembuatan Penelitian Tindakan Kelas Bagi Guru Sekolah Dasar Di Kecamatan Barabai Kabupaten Hulu Sungai Tengah: The Workshop of Making the Classroom Action Research for Elementary Teacher at Hulu Sungai Tengah," *PengabdianMu: Jurnal Ilmiah Pengabdian Kepada Masyarakat* 6, no. 2 (2021): 170–74

to succeed or fail. If the researcher feels that the results are unsatisfactory, the second action will be tried again. In classroom action research, there is rarely success that can be achieved in one action, which is why classroom action research is often done in several action cycles. The effect of action research is then studied and reported in-depth and systematically. Classroom action research aims to develop the most efficient and effective learning strategies in natural situations (not experiments). Action research assumes that knowledge can be built from experience, specifically, experience gained through action. With this assumption, ordinary people have the opportunity to improve their abilities through research actions. Researchers who conduct action research are assumed to have the expertise to change the conditions, behavior, and abilities of the subject (student) who is the research target.

Classroom action research has four stages: planning, implementation, observation, and reflection.[30] These stages must be carried out by the existing sequence and procedures of structured planning as the initial stage in applying the *Problem-Based Learning method*. From careful planning, the action carried out is implementation. Good execution determines the outcome of the success of the methods performed. Observe the implementation of *Problem-Based Learning* to stay on the planned path. Reflect on the results of applying the *Problem-Based Learning* method and whether it is what has been expected. Repeat these steps until a problem is considered resolved.

Classroom Action Research *is* carried out as an implementation plan in cycle I and cycle II, including:[31]

a. Planning

Activities are carried out to determine the learning outcomes of students majoring in welding engineering by observing and analyzing problems in the classroom. After knowing the problems in the classroom, action must be taken to solve an existing problem. They solve problems by preparing a Learning Implementation Plan (RPP) on welding defects.

b. Implementation

[30] Rida Prihatni, Ati Sumiati, and Tuty Sariwulan, "Pelatihan Penelitian Tindakan Kelas Untuk Guru-Guru Yayasan," *Jurnal Pemberdayaan Masyarakat Madani (JPMM)* 3, no. 1 (2019): 112–23.
[31] Yuafian, Reza, and Suhandi Astuti. "Peningkatan Hasil Belajar Siswa Menggunakan Model Pembelajaran Problem Based Learning (PBL)." *JRPD (Jurnal Riset Pendidikan Dasar)* 3.1 (2020): 17-24.

This research plan is in the form of research work procedures or actions in the classroom. Implementation of actions in cycle I by the planning that has been planned in the Learning Implementation Plan (RPP).

c. Observation

Observation is made at the time of execution of the action. It involves teachers collaborating with students to determine interests and outcomes on sheets and observations made by observation. After making observations and research, students will be held to an evaluation of the implementation action.

d. Reflection

Reflection activities carried out after implementation in cycle I are to see the strengths and weaknesses in students when carrying out actions taken to improve learning in the next cycle. The results of this reflection are used to determine interests and outcomes of Student learning; then, what will be achieved when preparing an activity plan in cycle II is to take a learning approach used as an action.

The subjects carried out in this study were grade XI Las 2 students at SMKN 1 Udanawu, Blitar Regency, for the 2022/2023 academic year held in semester 1. The object outlined in this research is *Problem-Based Learning*, which aims to improve the quality of learning, and students can assess the quality of welding carried out. The result is that students can improve the quality of welding that has been done.

This time, the techniques carried out in collecting research data are tests and observations. The test is a method used in collecting data through pretest and posttest (same questions). In this case, observation is when applying *Problem-Based Learning* by doing a checklist (√). Every implementation that has been carried out will be given a checklist (√).

The data obtained will be analyzed descriptively and elaborated by the data obtained from the research results.

RESULT

The data obtained from this study comes from the initial conditions before the treatment of students through *Problem-Based Learning and those who have been given* Problem-Based Learning learning treatment *so that they can be analyzed.*

The data obtained are the results of the precycle, silkus I, and Cycle II.

Table 1. Learning outcomes of class XI Las 2 students

Phase	Top Rated	Lowest Value	Complete	Incomplete	Average rating
Precycle	75	10	4	30	30,2
Cycle I	80	30	15	19	56,4
Cycle II	95	50	30	4	81,3

In the table above, it can be seen that the data on the results of the precycle, cycle I, and cycle II shows an increase in the average learning of grade XI Las 2 SMKN 1 Udanawu students, which initially only reached 30.2 which is very less than the minimum completeness score achieved which is 70. In the first cycle, there was a significant increase in the completeness results of grade XI Las 2 students of SMKN 1 Udanawu, with a value of 56.4. However, the resulting value was still below the minimum completeness score. The assessment continued in the 2nd cycle with a score of 81.3. In cycle II, there was a very significant increase so that the scores obtained by grade XI Las 2 SMKN 1 Udanawu students could reach the minimum completeness value determined.

Table 1 above shows a graph of the completeness value of grade XI Las 2 SMKN 1 Udanawu students.

Figure 1. Graph of learning outcomes of class XI students Las 2

It can be seen in picture 1, namely the increase in the minimum completeness score of grade XI Las 2 students of SMKN 1 Udanawu. This can be seen by a significant rise in the line upwards. From the graph, the

precycle value shows a value of 26.9, while in cycle I, the graph shows a value of 50.2, and in the last cycle, cycle II, it shows a value of 83.6.

Based on Table 1 and Figure 1, there is a comparison of the increase in learning outcomes in class XI welding defects of SMK Negeri 1 Udanawu for the 2022/2023 academic year in the precycle, cycle I, and cycle II. In the precycle, four students completed, then increased to 15 in cycle I and increased to 30 students in cycle II. In learning to apply the Problem-Based Learning *learning model,* students are focused on thinking backward to resequence learning events that have been done, especially those related to defects in welding.

In precycle learning, students need to be more focused on contextual learning. Learning outcomes are measured through test results, which are cognitive aspects. In contrast, the other two aspects, affective and psychomotor, have never been measured, which is part of determining learning outcomes. In the learning results in the first cycle, there was an increase in the *Problem-Based Learning* learning model by being made in groups. This makes it easier for students who need help understanding to ask their theme regarding the problem of welding defects. In cycle II, *Problem-Based Learning* is more developed by making group presentations. That way, students understanding and learning outcomes in cycle II also increase significantly.

DISCUSSION

All stages of research have been carried out, starting from the *pretest* and *posttest*, as an evaluation of learning. An average completeness score of 30.2 was obtained in the pre-action or precycle phase. These results show that students still need to understand the material about defects in welding. In this case, an action I am carried out called cycle I by providing treatment of *the Problem-Based Learning* learning model. At the stage of cycle I, students are made in groups and identify themselves related to welding defects that arise after performing welding. The formation of groups randomly and evenly so that all students can be involved in problem-solving can increase the stimulation to students to read, search, and understand the given problem so that an average completeness score of 56.4 is obtained in cycle I. In cycle I, there is an increase in student learning outcomes, but this result still needs improvement and needs improvement. The factor that results in the lack of maximum learning results in cycle I is the need for repetition and emphasis on welding defective material. Therefore, to improve student learning outcomes, it is necessary to hold cycle II.

In cycle II, the Problem-Based Learning *learning model is carried out with* activities for students to present in front of the class with welding defect material. The repetition of varied materials and activities will increase students' understanding of welding defect material. So, in the second cycle that has been implemented, there is a significant improvement in student learning outcomes, with an average completeness score of 81.3. This result has met the minimum completeness value set at 70. With a little reinforcement of the material from the teacher, students are confident in their understanding, and make students understand more related to the material discussed. Students with obstacles can be assisted by group mates who understand better so that students who are hampered become more understanding of the material being discussed. This follows research conducted by Nugraha (2019). Using the *Problem-Based Learning* method is one of the efforts to improve description writing skills.[32] With a method that directs students in problems, students can explore their information related to how to solve problems so that students can construct their related information in the learning process to improve student learning outcomes significantly.[33]

Another study conducted by Ririn (2021) states that the research results on problem-based learning (*Problem-Based Learning*) are quite effective in developing students' abilities and learning.[34] Students also have character values in learning activities, such as responsibility, cooperation, democracy, and others, and students can actively participate in expressing their opinions. In the study, it is very clear that there is an increase in student learning outcomes with problem-based methods (*Problem-Based Learning*).

The results of the research conducted by the author are also by research conducted by Rombe (2021) stating that the *Problem-Based Learning learning model* provides significant improvements to students from cycle I to cycle II, respectively, through the stages of planning, implementation, observation, and

[32] Junaedi Nugraha, M S Zulela, and Nurhattati Fuad, "Peningkatan Keterampilan Menulis Deskripsi Melalui Pendekatan Saintifik Dengan Metode Problem Based Learning Di Kelas Iv Sekolah Dasar," in *Prosiding Seminar Nasional Pendidikan KALUNI*, vol. 2, 2019.

[33] Adah Nursaadah and Roni Rodiyana, "Implementasi Model Pembelajaran Problem Based Learning Sebagai Keterampilan Menulis Deskripsi Siswa Pada Abad 21," *Buletin Ilmiah Pendidikan* 2, no. 1 (2023): 92–100.

[34] Ririn Widiawati, Hikmawati Hikmawati, and Jannatin Ardhuha, "Pengembangan Perangkat Pembelajaran Berbasis Model Problem Based Learning Untuk Meningkatkan Kemampuan Pemecahan Masalah Fisika Peserta Didik Pada Materi Fluida Dinamis," *Jurnal Ilmiah Profesi Pendidikan* 7, no. 3c (2022): 1803–10.

reflection. The study results in the first cycle of the number of students who completed as many as 20 people with an average learning outcome of 72.06 and a classical percentage of 62.50. In cycle II, there was an increase with students who completed learning increased to 27 students; the average learning outcome was 85, and the classical percentage was 84.37%. There was an increase in the learning outcomes of class XI Las students, with a percentage increase of 21.87% from cycle I to cycle II.

In their research, Khaerudin & Refiadi (2020), the Problem-Based Learning *Method* has proven its superiority in SMAW welding learning at SMA Ma'arif 1 Sumedang by achieving better learning outcomes. The score is 93.3% average, close to the maximum score. Similarly, the significance of the *Problem-Based Learning method* on SMAW welding learning outcomes has been statistically proven through t-test values that accept the null hypothesis, H0. The *Problem-Based Learning* method has provided understanding and improved skills in SMAW welding techniques. Physical evidence is the absence of undercut defects on the weld surface after students received *Problem-Based Learning treatment*. This is proof that students better understand welding techniques and good weld positions.

From the description above, the occurrence of a significant increase in student completeness scores is in line with research conducted by previous researchers. This study shows a significant difference between the learning outcomes of students taught using *the Problem-Based Learning learning model and before learning with* the Problem-Based Learning model.[35] Thus, in addition to increasing the completeness value, students can assess for themselves the quality results of welding based on an understanding of the various welding defects obtained through the *Problem-Based Learning* learning method. This learning method has provided an understanding and improvement of skills in welding techniques.

[35] Rofi'i, Muhamad Irfan, Syarif Suhartadi, and Partono. "The Effect of the Problem-Based Learning Model on Student Learning Outcomes on the Competence of Gasoline Injection Fuel System Maintenance at SMKN 11 Malang City." *Journal of Automotive Engineering: Scientific and Teaching Studies* 5.2 (2021): 37-40.

CONCLUSION

Based on the results and discussions that have been carried out, it can be concluded that there is an increase in the average completeness results of students from the precycle, cycle I, and cycle II students of grade XI Las 2 SMKN 1 Udanawu which initially only reached 30.2 in the precycle to 56.4 in cycle I and in cycle II to 81.3. This happens because, in practice-based learning, students only concentrate on practice and ignore theories related to welding defects. After Problem-*Based Learning is carried out,* students better understand the causes and effects of welding defects that arise. The factor that increases student understanding in cycles I and II is that learning is made in groups, so students are more active in identifying welding defects. With a little reinforcement of the material from the teacher, students are confident in their understanding, and make students understand more related to the material discussed. Students with obstacles can be assisted by group mates who understand better so that students who are hampered become more understanding of the material being discussed. In cycle II, students present the identification results so that students indirectly understand the material related to welding defects. Repetitive delivery of material through presentation is very helpful for students in understanding welding defect material. Students can assess the welding quality performed from the increase in the average value of learning outcomes on welding defect material.

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