Lensa: Jurnal Kependidikan Fisika
Penerbit: Universitas Pendidikan Mandalika
https://e-journal.undikma.ac.id/index.php/Lensa/index

Dec. 2025, Vol. 13, No. 2
e-ISSN: 2686-0937
pp. 430-438

Implementation of PBL-Based Experimental Method Improves Students' Physics Learning Outcomes

Ika Trisni Simangunsong[1*], Merta Simbolon[1], Nani Sri Rezeki[2], Dede Parsaoran Damanik[2]

[1] Physics Education Department, Universitas Musamus, Merauke, Indonesia
[2] Physics Education Department, Universitas Darma Agung, Medan, Indonesia

*Corresponding Author: ikatrisni@unmusl.com

Abstract

Education plays a role in improving student understanding. Improving learning outcomes is influenced by a supportive learning environment. This class action research aims to see the improvement of students' physics learning outcomes through the application of the experimental method based on Problem Based Learning in the odd semester of the 2024/2025 school year. Students of class XII-6 of one of the high schools in Merauke became the sample of this study, there were 35 students. The form of research used in classroom action research. Instruments used in teacher validation, to be adjusted to the expected learning outcomes, consisting of 5 essay questions. The indicators of the success of the study are, (1) The criteria for classical completeness of all students ≥ 85%. (2) the minimum criteria of the class is ≥70. The application of the PBL-based experimental method was completed after applying cycle II. The final results found 28 students experienced learning completeness. The achievement of 80% of students who were classically complete, and also reached the minimum criteria. There is an increase in student learning outcomes through the application of PBL-based experimental methods.

Keywords: Problem based learning; Experimental method; Physics learning outcomes; Classroom action research

How to cite: Simangunsong, I. T., Simbolon, M., Rezeki, N. S., & Damanik, D. P. (2025). Implementation of PBL-Based Experimental Method Improves Students' Physics Learning Outcomes. *Lensa: Jurnal Kependidikan Fisika*, *13*(2), 430–438. https://doi.org/10.33394/j-lkf.v13i2.16475

INTRODUCTION

Numeracy is a common skill that must be possessed because in life we must find many situations that involve mathematics. In the world of education, teachers need an innovative approach to designing the learning process. One of them is meaningful learning, a situation where students are involved. Students construct knowledge through real experiences, this is part of providing flexibility to find, analyze, explain the information obtained into knowledge (Nuriana & Hotimah, 2023). Physics is one of the lessons related to science. Science can be learned through the experimental learning process. The process that is carried out develops students' thinking skills through the activities of observing an object, analyzing, proving, and ending in drawing conclusions (Ma'viyah, n.d.). Experiments provide opportunities for students both individually and in groups to experience new knowledge for themselves. Ideally, physics lessons foster students' thinking skills in solving problems (Pratama et al., 2020).

Based on observations made during the PPL period, in one of the high schools in Merauke district, experimental learning is still minimally used. Students find physics concepts through textbooks, or direct teacher delivery. In fact, teachers deliver physics concepts directly. In fact, the average score of physics is lower than other subjects in class XII-6 students. Students find it difficult to solve problems (in the form of problems), they do not understand the meaning and use of physics concepts in the form of formulas. The weakness of physics problem solving ability is based on the presentation of physics learning that rarely involves students in discovering knowledge directly (Simangunsong et al., 2023). Learners only know the concept, not understanding, so that it has an impact on the ability to solve these problems. The learning process is one of the factors to increase students' enthusiasm for learning, especially in lessons related to numeracy (Rahma & Sutami, 2023). Based on Piaget's theory, learning should involve students through direct experience, which can be in the form of experiments, to discover new knowledge (Rahayu, 2019). A varied learning process is presented to foster interest and physics learning outcomes (Kurniawan et al., 2023).

Today's learning era requires learners to collaborate with each other. Collaborative learning emphasizes the learning environment through group work, in order to achieve shared learning goals (Faniashi et al., 2023). Learning activities are ideally able to guide learners to interact with peers through collaboration, which also supports the improvement of communication skills, to problem solving (Simangunsong et al., 2024). A learning atmosphere that involves learners, forms of cooperation, affects the improvement of thinking skills, as well as learning outcomes (Effendi, 2017). The experimental method is able to lead students to record facts, discover new knowledge, compile a statement of thought based on scientific observations (Subekti & Ariswan, 2016). Experiments make learners more interested and believe in the truth or conclusions based on their own experiments rather than just accepting the teacher's explanation or what is in the book. Teachers develop active learner involvement during the learning process whether it is physical, mental, or emotional in the experimental method.

The experimental method provides opportunities for students to practice their process skills so as to provide direct experience that can be embedded in their memories in order to obtain maximum learning outcomes. Because physics learning talks about concepts, it is the concept that must be emphasized by the teacher. Experiments emphasize activities through experiments, the process of proof, so that students are led to conclude based on the information and facts obtained, and (Sunarsih, 2020; Suryani et al., 2022), an effective strategy for the formation of thinking, and hands simultaneously (Darta, 2020). The purpose of using the experimental method; do, prove through experiments; explore knowledge, train; find out the initial theory directly (Riska, 2023). So students need the "ability" to build new knowledge to solve physics problems, this ability is problem solving ability (Kiraga, 2023). Learners will be enthusiastic when the learning process involves them, so this affects learning outcomes (Ekawati & Sunarno, 2017). Learning outcomes are obtained from changes in knowledge, attitudes, and skills.

METHOD

The research was conducted by implementing classroom action research (CAR), which is a form of reflective research that involves taking certain actions to improve or enhance learning practices in the classroom. This research is classroom action research, which is a form of reflective research that involves taking certain actions to improve or enhance learning practices in the classroom Researchers acted as teachers, and there were those who act as observers The design is in several cycles, each cycle through the stages of planning, implementation, observation, and reflection. The research cycle used is as follows.

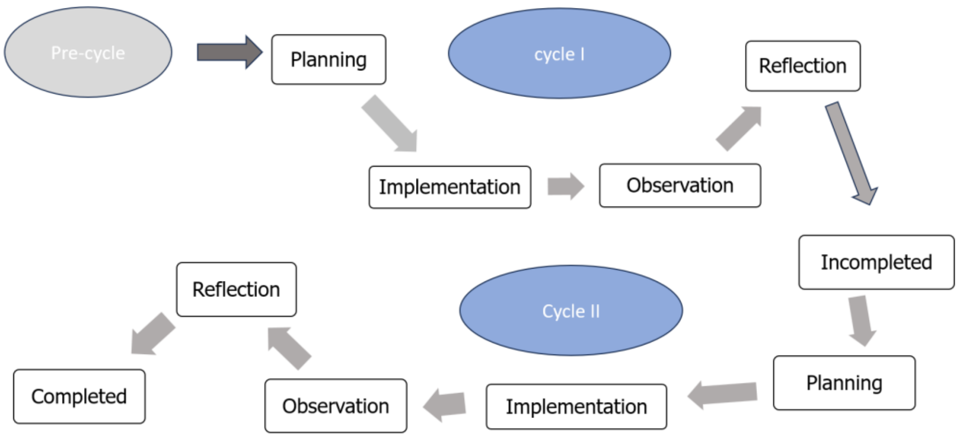

Figure 1. Classroom action research

The activity was carried out in one of the schools in Merauke in the odd semester of the 2024/2025 school year, class XII-6, with 35 students. The instrument used is a test in the form of 5 physics questions. Research seeks to optimize learning by using experimental methods to improve student learning outcomes. The presence of researchers as designers, implementers, data collectors, analyzing data, and reporting results. XII-6 class students as research subjects. Data obtained in the study regarding the learning process, which explains the learning of experimental methods can improve students' physics problem solving skills. The data obtained was then analyzed using quantitative descriptive analysis techniques. The application of the experimental method is said to be effective if the expected indicators are achieved, as for the success indicators of this study, namely; the criteria for classical completeness of all students ≥ 85%.

RESULTS AND DISCUSSION

The pre-cycle research was carried out for 3 lesson hours (3 × 40 minutes). Data on the test results of XII-6 class students in Physics subject Magnetic Induction material shows that the passing rate of students is still low. There are still many students who have not reached the minimum criteria. PBL consists of five phases, namely: orienting students to the problem (guiding students in worksheet activities), organizing students into study groups (observers observe students in groups), guiding the investigation (teachers observe groups that are having difficulties), presenting results (teachers encourage students to present their findings in groups), and evaluation (explaining conclusions and important concepts that need to be repeated or emphasized). The data on the Physics test scores of XII-6 class students can be seen in the table below:

Table 1. Pre-cycle results

Initial	Pre-cycle	Minimum Criteria	Description
AD	70	70	Completed
AM	70	70	Completed
AS	60	70	Incompleted

Initial	Pre-cycle	Minimum Criteria	Description
AN	40	70	Incompleted
AR	60	70	Incompleted
AF	40	70	Incompleted
AP	40	70	Incompleted
AB	50	70	Incompleted
CA	60	70	Incompleted
DA	60	70	Incompleted
DI	60	70	Incompleted
ES	70	70	Completed
FA	40	70	Incompleted
HA	40	70	Incompleted
IH	50	70	Incompleted
IS	50	70	Incompleted
KA	80	70	Completed
MP	70	70	Completed
NS	50	70	Incompleted
NA	70	70	Completed
NS	70	70	Completed
RJ	40	70	Incompleted
RF	40	70	Incompleted
RP	70	70	Completed
RD	70	70	Completed
RA	60	70	Incompleted
RY	40	70	Incompleted
SI	40	70	Incompleted
SP	60	70	Incompleted
SP	50	70	Incompleted
SA	50	70	Incompleted
SR	70	70	Completed
TA	20	70	Incompleted
ZN	50	70	Incompleted
ZF	50	70	Incompleted

Based on the data obtained from the implementation of this pre-cycle, it turns out that the level of learning completeness of students is still in the low category, namely only 10 students who are complete (28.57%) and as many as 25 students who are not complete (71.43%) with an average class score of 54.57. With the data that has been obtained, then the researcher will conduct classroom action research by applying experimental learning methods with the aim of improving student learning outcomes. Cycle I was carried out on learning Magnetic Induction material applying experimental methods. In conducting this class action research, in addition to delivering the subject matter, the researcher also observed the activities of students during the learning process. Learning activities end with doing test questions, with the aim of knowing the level of success of students in mastering the material. The results of the students' scores are also used as an indicator of the success of learning with the experimental method.

In this cycle, students appeared very enthusiastic and curious in following the lesson. The teacher explained a simple magnetic induction experiment and asked students to observe the steps involved in conducting the experiment. Students were asked to conduct a simple magnetic induction experiment using the prepared experimental materials. The teacher provided an explanation of the experiment that had been conducted. Students were very enthusiastic during this activity because they were curious about the results of their experiments. Before the lesson ended, the teacher distributed test questions. This was done with the aim of determining the level of success of the students in understanding the material that had been delivered as well as an indicator of learning success.

After applying the experimental method, learning activities can take place interestingly, this can be seen from students who are very enthusiastic in assembling and observing experimental materials. Completeness reached 51.43%, the average score was 66.29, the learning scores of students had increased compared to the scores at the time of the pre-cycle, but had not yet reached the target. During the observation, several problems were still found, namely: (1) Teachers have not been able to motivate students; (2) Teachers have not been able to mobilize efficient teaching positions; (3) Teachers have not been able to allocate time appropriately; (4) Teachers are still less effective and efficient in the use of media; (5) Teachers still do not involve students in the use of media; (6) Teachers have not given assignments to students; (7) Most female students are still less active in the process of assembling experimental materials; (8) Students still often joke and talk to themselves so they pay less attention. So that researchers will continue research in the next cycle with the same learning method, namely the experimental learning method by fixing the shortcomings in cycle I.

In this cycle, learners seemed very enthusiastic and curious in participating in the lesson. The teacher explained the simple experiment of magnetic induction and students were asked to see the steps in conducting the experiment. Learners are asked to conduct a simple experiment on magnetic induction with experimental materials that have been assembled. The teacher provides an explanation of the experiments that have been carried out. In this activity, students are very enthusiastic because they are curious about the results of their experiments. Before the lesson was over, the teacher distributed test questions. This is done with the aim of knowing the level of success of students in understanding the material that has been delivered as well as an indicator of the success of learning. From the results of the first cycle test, it shows that the learning outcomes of students have increased, which previously in the pre-cycle the number of students who completed only 10 people (28.57%) increased to 18 people (51.43%) in the first cycle.

Cycle II was carried out, still applying the experimental method by making improvements based on reflections on cycle I. At the end of the lesson, the teacher gave test questions for students to do. The purpose of this test is to determine the level of success of students in mastering the material. After making improvements in implementing cycle II, it has been categorized as successful because the level of learning completeness of students has reached the target of 80% with an average class score of 80.

Table 2. Comparing pre-cycle, cycle 1, and cycle 2

Completeness	Pre-Cycle	Cycle 1	Cycle 2
Completed	10	18	28
Incompleted	25	17	7
Total	54.57	66.29	2800

Completeness	Pre-Cycle	Cycle 1	Cycle 2
Average	1910	2320	80

The results of the students' scores are also used as an indicator of the success of learning with the experimental method. Data on student test scores in cycles 1 and 2 can be seen in the Table 3.

Table 3. Cycle I and Cycle II Results

Initial	Cycle I	Description	Minimum Criteria	Cycle II	Description
AD	80	Completed	70	90	Completed
AM	90	Completed	70	100	Completed
AA	80	Completed	70	100	Completed
AN	70	Completed	70	80	Completed
AR	70	Completed	70	80	Completed
AF	60	Incompleted	70	60	Incompleted
AP	60	Incompleted	70	60	Incompleted
AB	70	Completed	70	90	Completed
CA	70	Completed	70	90	Completed
DA	80	Completed	70	90	Completed
DI	70	Completed	70	80	Completed
ES	80	Completed	70	90	Completed
FA	50	Incompleted	70	70	Completed
HA	60	Incompleted	70	80	Completed
IH	60	Incompleted	70	80	Completed
IS	60	Incompleted	70	80	Completed
KA	90	Completed	70	100	Completed
MP	70	Completed	70	80	Completed
NS	60	Incompleted	70	70	Completed
NA	80	Completed	70	80	Completed
NS	80	Completed	70	80	Completed
RJ	50	Incompleted	70	60	Incompleted
RF	50	Incompleted	70	60	Incompleted
RP	70	Completed	70	80	Completed
RD	70	Completed	70	80	Completed
RA	70	Completed	70	80	Completed
RY	50	Incompleted	70	60	Incompleted
SI	50	Incompleted	70	60	Incompleted
SP	60	Incompleted	70	90	Completed
SP	60	Incompleted	70	90	Completed
SA	60	Incompleted	70	100	Completed
SR	70	Completed	70	100	Completed
TA	50	Incompleted	70	60	Incompleted
ZN	60	Incompleted	70	70	Completed
ZF	60	Incompleted	70	80	Completed

Based on the results of observations made by researchers during the pre-cycle in class XII-6, Magnetic Induction material for 25 students is still below the predetermined minimum criteria, 70. Furthermore, from the results of these pre-cycle observations, researchers tried to offer and innovate learning by applying experimental learning methods. In cycle I, 18 students achieved learning completeness, while 17 students were still found to be incomplete. Cycle II, 28 students reached mastery, only 7 students were not complete. Graphically it can be visualized through the chart

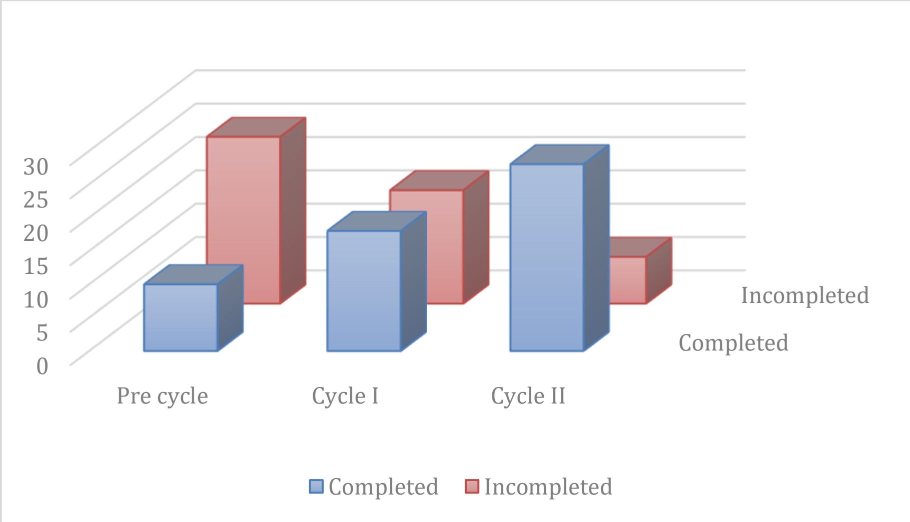

Figure 2. Comparison of the number of students in the cycle

Through the experimental method, students can experience the scientific process, gaining knowledge directly (Saraswati et al., 2020). The activities presented in PBL and the experimental method have similar characteristics, leading students to achieve real knowledge findings (Simangunsong et al., 2024). This collaboration is a combination to create contextualized learning for students, which leads to the achievement of targeted learning outcomes. PBL leads to meaningful learning, linking problems in learning, students gain "connections" so that they gain "meaning" in physics learning (Hidayah et al., 2018).

In this classroom action research, the researcher has succeeded in improving the learning outcomes of Physics in the subject of Magnetic Induction for students in class XII-6 at one of State Senior High School in Merauke, 80% achieving the minimum passing grade. Therefore, the implementation of the cycle stopped at cycle II. Unlike the previous cycle, learning in cycle II ran more smoothly, with students concentrating better and talking less. As in cycle I, before the lesson ended, the teacher distributed test questions to assess the students' level of understanding of the material presented and to gauge the success of the lesson. Teachers must continue to innovate in implementing learning so that learning activities can be effective and enjoyable.

Experimental methods can make students more interested and confident in the truth or conclusions based on their own experiments rather than just accepting explanations from teachers or books. Teachers can actively engage students during the learning process, whether physically, mentally, or emotionally, using experimental methods. This involvement improves students' understanding of the material presented, thereby improving their learning outcomes. The experimental method applied in PBL provides students with the opportunity to practice their process skills, giving them direct experiences that can be embedded in their memory to achieve maximum learning outcomes.

CONCLUSION

Based on the results of class action research, this research can be said to be successful, this can be seen from the recapitulation of the average value of pre-cycle students who have increased, from the average value of the class starting from the pre-cycle, the percentage of students who completed was 10 students or 28.57% and those who were not complete were 25 students or 71.43% with an average class value of 54.57. Furthermore, in cycle I the percentage of students who completed the minimum criteria, was 18 people or 51.43% and those who were not complete were 17 people or 48.57% with an average class score of 66.29. Then, in cycle II the percentage of students who completed the minimum criteria was 28 people or 80% with an average class score of 80. In cycle II, classical completeness has reached the target of 80%.

RECOMMENDATION

PBL-based experimental activities require a companion in grouping students, researchers should provide one companion in each group, so that students get maximum assistance.

ACKNOWLEDGMENT

The author is grateful to all parties involved in this research, physics education students who have participated in the role, the school that has given the opportunity as a research subject.

REFERENCES

Darta, I. K. (2020). *Upaya Meningkatkan Hasil Belajar Fisika Melalui Model Pembelajaran Berbasis Masalah (Problem Based Learning) Pada Siswa Kelas XI IPA SMA Negeri 1 Marga*. https://doi.org/10.5281/zenodo.4003999

Effendi. (2017). *Hubungan Readiness (Kesiapan) Belajar Siswa Dengan Hasil Belajar Fisika Siswa Kelas X Smk Muhammadiyah 03 Sukaraja*.

Ekawati, Y., & Sunarno, W. (2017). *Pembelajaran Fisika Melalui Discovery Learning Dengan Metode Eksperimen Dan Demonstrasi Ditinjau Dari Kemampuan Berpikir Kritis Dan Kreativitas Siswa Smk Kelas X Pada Materi Sifat Mekanik Bahan* (Vol. 6, Issue 3). http://jurnal.uns.ac.id/inkuiri

Faniashi, N. R. C., Astra, I. M., & Susanti, D. (2023). *Model Pembelajaran Kolaboratif Berbasis Stem (Science, Technology, Engineering, And Mathematics) Terhadap Hasil Belajar Kognitif Fisika Peserta Didik SMA*. https://doi.org/10.21009/03.1102.pf42

Hidayah, S. N., Pujani, N. M., & Sujanem, R. (2018). Implementasi Model Problem Based Learning Untuk Meningkatkan Aktivitas Belajar Dan Kemampuan Pemecahan Masalah Fisika Siswa Kelas X MIPA 2 MAN Buleleng Tahun Pelajaran 2017/2018. *Jppf*, *8*(1), 2599–2554.

Kiraga, F. (2023). A Study Of Problem Solving In Physics Learning: A Systematic Review. *EduFisika: Jurnal Pendidikan Fisika*, *8*(3), 303–315. https://doi.org/10.59052/edufisika.v8i3.29446

Kurniawan, A. F., Ristanto, S., & Khoiri, N. (2023). *Reasons for Students Interest in Learning Physics Subjects in Senior High School*. https://doi.org/10.21009/1

Ma'viyah, A. (n.d.). *Metode Eksperimen Dalam Pembelajaran Sains Untuk Anak Usia Dini (Experimental Methods In Science Learning For Early Childhood)* (Vol. 3).

Nuriana, R., & Hotimah, I. H. (2023). *Penerapan Meaningful Learning Dalam Pembelajaran Sejarah*. *5*(2).

Pratama, A., Sugiyanto, S., & Nugroho, S. E. (2020). *Pengembangan Modul Eksperimen Fisika Berbasis Analisis Video pada Topik Mekanika untuk Siswa SMA*. 50229. http://journal.unnes.ac.id/sju/index.php/upej

Rahayu, I. A. T. (2019). *Mengembangkan Keterampilan Memecahkan Masalah Melalui Pembelajaran Berdasar Masalah*.

Rahma, T. T., & Sutami, S. (2023). Kemampuan Pemecahan Masalah Matematika Realistik dengan Langkah Polya Pada Siswa SMP. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *7*(2), 1416–1426. https://doi.org/10.31004/cendekia.v7i2.2406

Riska, Y. A. S. I. S. (2023). *Pengaruh Metode Eksperimen Terhadap Hasil Belajar Peserta didik Pada Materi* Sumber Energi. *Jurnal Ilmiah Mahasiswa, 8*(2). http://www.jim.unsyiah.ac.id/pgsd/indexll

Saraswati, D., Sunarno, W., & Rahardjo, D. T. (2020). Pengaruh Pengajaran Fisika dengan Menggunakan Model Problem Based Learning (PBL) Melalui Metode Eksperimen dan Demonstrasi Ditinjau dari Kemampuan Matematika Terhadap Kemampuan Kognitif Siswa pada Materi Elastisitas dan Hukum Hooke Kelas X di SMA Negeri 8. *Jurnal Materi Dan Pembelajaran Fisika*, *10*(2), 89. https://doi.org/10.20961/jmpf.v10i2.45449

Simangunsong, I. T., Panjaitan, J., & Panggabean, D. D. (2023). Problem Based Learning Terhadap Penguasaan Konsep Dan Kemampuan Pemecahan Masalah Mahasiswa. *Natural Science: Jurnal Penelitian Bidang IPA Dan Pendidikan IPA*, *9*(2), 156–166.

Simangunsong, I. T., Uskenat, K., Damanik, D. P., Simangunsong, I. P., & Purba, A. A. (2024). Improvement of High School Students' Physics Problem Solving Skills Through Problem Based Learning Assisted by LKPD (Student Worksheets). *Lensa: Jurnal Kependidikan Fisika*, *12*(2), 275. https://doi.org/10.33394/j-lkf.v12i2.13544

Subekti, Y., & Ariswan, A. (2016). Pembelajaran fisika dengan metode eksperimen untuk meningkatkan hasil belajar kognitif dan keterampilan proses sains. *Jurnal Inovasi Pendidikan IPA*, *2*(2), 252. https://doi.org/10.21831/jipi.v2i2.6278

Sunarsih, S. (2020). Penerapan Metode Eksperimen Fisika untuk Meningkatkan Kemampuan Berpikir Kritis Dan Kreatif The Implementation Of Physics Experimental Method To Improve Critical Thinking And Creativity. In *Jurnal Karya Ilmiah Guru* (Vol. 5, Issue 2).

Suryani, E., & Rubianti, I. (2022). Penerapan Metode Eksperimen Untuk Meningkatkan Hasil Belajar IPA Pada Siswa SMPN 2 Woha Tahun Pelajaran 2021/2022. *JUPENJI: Jurnal Pendidikan Jompa Indonesia, 1*(1): 17-23. https://doi.org/10.55784/jupenji.Vol1.Iss1.82