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DEEP LEARNING INTEGRATED IN ACTION LEARNING TO ENHANCE JUNIOR HIGH SCHOOL STUDENTS' PROBLEM-SOLVING SKILLS

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Abstrak

Kemampuan pemecahan masalah matematika yang rendah pada siswa SMP sering disebabkan oleh proses pembelajaran yang bersifat dangkal dan kurang kontekstual. Penelitian ini bertujuan untuk menganalisis pengaruh model pembelajaran In Action yang terintegrasi dengan *Deep Learning* terhadap kemampuan pemecahan masalah siswa SMP. Metode penelitian yang digunakan adalah kuasi-eksperimen dengan desain kontrol *posttest-only*. Populasi penelitian meliputi seluruh siswa kelas VIII di sebuah SMP Negeri, dengan sampel berupa dua kelas yang dipilih melalui teknik *cluster random sampling*. Instrumen penelitian terdiri dari tes deskriptif kemampuan pemecahan masalah yang disusun berdasarkan indikator Polya. Data dianalisis menggunakan Uji Independent Sample t-test setelah memenuhi tes prasyarat normalitas dan homogenitas. Hasil menunjukkan perbedaan yang signifikan dalam kemampuan pemecahan masalah antara kelompok eksperimen dan kelompok kontrol ($p < 0,05$). Rata-rata skor *posttest* untuk kelas eksperimen (82,45) secara signifikan lebih tinggi daripada kelas kontrol (71,20). Integrasi *In Action* memberikan pengalaman belajar langsung, sementara *Deep Learning* memfasilitasi pemahaman konseptual yang mendalam. Studi ini menyimpulkan bahwa pembelajaran *In Action* yang diintegrasikan dengan *Deep Learning* efektif dalam meningkatkan kemampuan pemecahan masalah siswa dan dapat menjadi model pembelajaran alternatif yang inovatif di sekolah.

Abstract

The low mathematical problem-solving ability of Junior High School students is often caused by learning processes that are superficial and lack context. This study aims to analyze the effect of the In Action learning model integrated with Deep Learning on the problem-solving abilities of junior high school students. The research method employed was a quasi-experiment with a posttest-only control design. The population included all eighth-grade students at a public junior high school, with a sample of two classes selected through cluster random sampling. The research instrument consisted of a descriptive test of problem-solving abilities structured based on Polya's indicators. Data were analyzed using the Independent Sample T-Test after fulfilling the prerequisite tests for normality and homogeneity. The results indicated a significant difference in problem-solving abilities between the experimental group and the control group ($p < 0.05$). The average posttest score for the experimental class (82.45) was significantly higher than that of the control class (71.20). The In Action integration provided direct learning experiences, while Deep Learning facilitated profound conceptual understanding. This study concludes that In Action learning integrated with Deep Learning is effective in enhancing students' problem-solving abilities and can serve as an innovative alternative learning model in schools.

Keywords: *In Action, Deep Learning, Problem-Solving Ability, Junior High School Students*

INTRODUCTION

Education is fundamentally a deliberate effort to develop human potential, encompassing intellectual capacity, personality, and skills that are relevant to contemporary societal demands. In the 21st century, the focus of education has shifted from the mere acquisition of knowledge to the development of complex and transferable competencies. Among these, problem-solving skills are considered essential (Az-Zahra et al., 2023; Bernard et al., 2018). This competency extends beyond routine procedural tasks and reflects students' ability to think logically, critically, and creatively when addressing complex and uncertain situations.

However, empirical evidence indicates that the problem-solving abilities of junior high school students remain a significant concern. Many students demonstrate proficiency in memorizing formulas, yet struggle when confronted with problems requiring deeper reasoning and real-world application. International assessments, such as PISA, consistently place Indonesian students at relatively low levels in terms of literacy and problem-solving performance (Lanya et al., 2021; OECD, 2019, 2021). This condition highlights a substantial gap between the intended curriculum and its implementation in classroom practice. One of the main contributing factors is the persistence of teacher-centered instructional approaches, where students function primarily as passive recipients of information, limiting the development of higher-order thinking skills.

At the junior high school level, students are undergoing a cognitive transition from concrete to abstract thinking (Nurmala R et al., 2019; Panjaitan et al., 2024; Wulandari, S. Hermansyah & Pratiwi, 2021). Failure to effectively support this transition often results in students perceiving learning as monotonous and disconnected from real-life relevance. Consequently, low problem-solving ability is frequently accompanied by a lack of learning autonomy (Bernard et al., 2018; Mardaleni et al., 2018). When students are habituated to receiving ready-made solutions, they tend to lose resilience or what is often referred to as the adversity quotient when faced with intellectually demanding tasks that require independent exploration. Therefore, a transformation in instructional approaches is necessary to actively engage students in meaningful learning processes. Learning should be designed to enable students not only to receive information, but also to experience, apply, and interpret knowledge in authentic contexts.

In this regard, the In Action Learning model is proposed as an innovative pedagogical framework to foster active engagement and deep understanding. This model facilitates a shift from passive learning environments to dynamic, student-centered learning ecosystems (Nurmala R et al., 2025c, 2025b, 2025a). The process begins with the Initial Abilities Focus phase, which emphasizes the identification of students' prior knowledge and cognitive readiness, thereby avoiding a one-size-fits-all approach. This is followed by the Connection phase, where abstract concepts are linked to real-world contexts to stimulate intrinsic motivation and meaningful engagement.

Student participation intensifies in the Construction phase, where learners actively construct knowledge through exploration, discussion, and collaboration. The knowledge developed in this phase is subsequently tested in the Application phase, which requires students to apply their understanding to complex problem-solving situations. Finally, the process culminates in the Evaluation and Reflection phase, where students critically examine their own thinking processes and learning experiences.

Through the integration of these five phases, the In Action Learning model promotes not only conceptual understanding but also the development of metacognitive awareness and sustainable problem-solving skills. However, the implementation of the In Action Learning model alone is insufficient if it is not supported by a corresponding depth of thinking. In this context, the integration of Deep Learning becomes essential.

The integration of In Action Learning and Deep Learning creates a more challenging and cognitively demanding learning environment. Students are not only engaged in direct problem-solving activities but are also guided to abstract, analyze, and critically reflect on their actions. This integrated approach aims to minimize the prevalence of surface learning, in which students merely memorize information without fully understanding underlying concepts. Instead, students are encouraged to seek meaning behind data, identify patterns, and construct well-organized knowledge structures within long-term memory.

This approach is also aligned with constructivist learning theory, which posits that knowledge is actively constructed by learners through interaction with their environment and peers. In this framework, the role of the teacher shifts from knowledge transmitter to facilitator, providing appropriate scaffolding without dominating students' cognitive processes. The implementation of this model at the junior high school level is particularly relevant, as it supports students' transition toward higher-order thinking.

Through structured stages of investigation and reflection, students are trained to avoid premature conclusions and instead analyze problems systematically by considering relevant variables. Another significant advantage of this integration is the enhancement of intrinsic motivation. When students perceive that learning activities are both action-oriented (In Action) and conceptually meaningful (Deep Learning), their engagement and curiosity increase substantially.

Despite its theoretical potential, empirical studies that explicitly integrate In Action Learning and Deep Learning to improve junior high school students' problem-solving skills remain limited. Most existing research tends to examine these approaches separately rather than as a unified framework. Therefore, this study aims to analyze and describe the effect of implementing an In Action Learning model integrated with Deep Learning strategies on students' mathematical problem-solving abilities at the junior high school level.

METHOD

This study employed a quantitative approach using a quasi-experimental method. The research design adopted was a post test-only control group design. In this design, no pretest was administered in order to avoid potential testing effects and instrument interaction bias. Instead, the outcomes were evaluated by comparing the post test results of the experimental group and the control group after the treatment had been completed.

Table 1. The research design adopted was a posttest-only control group design

Groups	Treatment	Posttest
Eksperimen	In *Action* Learning + *Deep Learning* (X)	Problem-Solving Ability Test (O1)
Controls	Conventional Learning/ Other Experiments	O2 Problem-Solving Ability Test)

Description:

X : Treatment in the form of In Action learning integrated with Deep Learning.
O1 : Post test score of experimental class problem-solving ability.
O2 : The post test score of the problem-solving ability of the control class.

Sampling was conducted using a cluster random sampling technique (Mucti & Nurmala R, 2020; Sugiyono, 2014). From the target population, two classes were randomly selected as research subjects. One class was assigned as the experimental group, which received the In Action Learning integrated with Deep Learning treatment, while the other class served as the control group and followed conventional instruction. Prior to the implementation of the treatment, both groups were verified to have comparable levels of academic ability based on students' previous academic records, such as report card scores or prior examination results. This step was undertaken to ensure initial group equivalence and to strengthen the internal validity of the study.

Data were collected using a primary instrument in the form of an essay-based mathematical problem-solving test. The instrument was specifically designed to assess students' problem-solving abilities based on Polya's stages, including understanding the problem, devising a plan, carrying out the plan, and reviewing the solution.Before being administered as a post test, the instrument underwent a rigorous validation process. Content validity was established through expert judgment, while empirical testing was conducted on students outside the research sample to evaluate the instrument's reliability, discrimination index, and difficulty level. In addition to the test instrument, an observation checklist was employed to monitor the implementation of the In Action Learning and Deep Learning syntax during the instructional process in the experimental class. This ensured that the treatment was delivered consistently and in accordance with the designed learning framework.

Data analysis was conducted through several statistical procedures to ensure the accuracy and validity of the findings. Post test scores from both groups were first subjected to prerequisite tests, including normality and homogeneity tests.The normality test, conducted using either the Shapiro–Wilk or Kolmogorov–Smirnov method, was used to determine whether the data distribution in both groups followed a normal distribution. Subsequently, a homogeneity test was performed to examine whether the variances of the two groups were statistically equal.If the assumptions of normality and homogeneity were satisfied, hypothesis testing was carried out using an independent samples t-test at a significance level of α = 0.05. However, if these assumptions were violated, a non-parametric alternative the Mann Whitney U test was employed. All statistical analyses were performed using SPSS software to minimize computational errors and ensure the robustness of the results. This analytical procedure enabled a reliable evaluation of the effect of In Action Learning integrated with Deep Learning on students' mathematical problem-solving abilities.

RESEARCH RESULTS AND DISCUSSION

Based on the results of the validated mathematical problem-solving ability test administered to both the experimental and control groups, the following findings were obtained

Table 2. Frequency Distribution of Problem-Solving Ability Scores

Value Interval	Category	Experimental Class Frequencies	Control Class Frequencies
91 – 100	Very High		1
81 – 90	Height	12	6
71 – 80	Medium	10	12
61 – 70	Low	3	8
≤ 60	Very Low	0	3

Table 3. Summary of Posttest Statistics of the Two Groups

Groups	N	Average	Standard Deviation	Min Value	Max Value
Eksperimen	30	82,45	7,12	65	95
Control	30	71,20	8,45	55	88

Table 4. Normality and Homogeneity Test Results

Prerequisite Test	Method	Nilai Sig.	Conclusion
Normalitas (Experiment)	Shapiro-Wilk	0,245	Normally Distributed
Normality (Control)	Shapiro-Wilk	0,189	Normally Distributed
Homogenites	Levene Test	0,312	Varians Homogen

Table 5. Average Difference Test Results (t-test)

Variabel	t-count	df	Sig. (2-tailed)	Remarks
Problem-Solving Capabilities	5,562	58	0,001	Signifikan

The data presented in this study represent the post test scores of students' mathematical experimental and control groups. Based on descriptive statistical analysis, the experimental group, which received In Action Learning integrated with Deep Learning, achieved a mean score of 82.45, with a maximum score of 95 and a minimum score of 65. In contrast, the control group, which followed conventional instruction, obtained a mean score of 71.20, with a maximum score of 88 and a minimum score of 55. These results indicate that the experimental group demonstrated a higher overall performance compared to the control group.

Prior to hypothesis testing, the posttest data were subjected to prerequisite tests. The normality test results indicated that the data from both groups were normally distributed ($p > 0.05$), while the homogeneity test confirmed that the variances were equal. Therefore, hypothesis testing was conducted using an independent samples t-test. The results showed a significance value (2-tailed) of 0.001, which is lower than the significance level of $\alpha = 0.05$. This result indicates that the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted, suggesting a statistically significant difference in problem-solving abilities between students exposed to In Action Learning integrated with Deep Learning and those receiving conventional instruction.

The findings demonstrate that the integration of In Action Learning and Deep Learning has a significant positive effect on junior high school students' problem-solving abilities. This improvement can be attributed to the learning structure, which actively engages students in both cognitive and experiential processes. In the In Action Learning approach, students are not limited to memorizing problem-solving procedures; instead, they actively experience the problem context and understand the rationale behind selecting specific solution strategies. Such active engagement contributes to deeper conceptual understanding compared to passive learning approaches.

These findings are consistent with previous studies indicating that activity-based learning enhances knowledge retention and conceptual understanding. Furthermore, the results align with research suggesting that Deep Learning approaches effectively shift students' focus from surface memorization to higher-order analytical thinking. The integration of these two approaches therefore creates a synergistic effect, resulting in more effective development of problem-solving skills compared to approaches that apply each strategy independently.

Moreover, Deep Learning in this study plays a critical role in strengthening students' analytical and reflective thinking abilities. Students are encouraged to establish meaningful connections between concepts and engage in critical reflection on their solutions. When faced with complex problems, they are better equipped to analyze relevant variables systematically rather than relying on trial-and-error strategies. This finding is consistent with constructivist learning theory, which emphasizes that knowledge constructed through active engagement and deep processing is more durable and transferable (Dhani et al., 2022; Nurhajati, 2014).

In addition, the learning environment in the experimental group was observed to be more dynamic and interactive. The integration of In Action Learning increased students' intrinsic motivation, as learning activities were directly linked to real-life contexts. This improvement is also reflected in students' ability to systematically follow Polya's problem-solving stages, particularly in planning solution strategies and reviewing results stages that are often overlooked in conventional learning settings. These findings suggest that the integrated model not only improves performance outcomes but also enhances the quality of students' cognitive processes.

CONCLUSION

Based on the results of the data analysis and discussion, it can be concluded that the implementation of In Action Learning integrated with Deep Learning has a significant effect on improving junior high school students' problem-solving abilities. This is evidenced by the statistically significant difference in mean scores between the experimental and control groups, with the experimental group demonstrating superior performance.

The integration of these two approaches has been shown to transform students' learning patterns from passive reception of information to active and meaningful engagement. In Action Learning provides contextual and experiential learning opportunities, while Deep Learning facilitates the development of deeper conceptual understanding and the ability to connect and apply knowledge in complex situations. As a result, this integrated model effectively supports the development of critical and systematic thinking skills required in mathematical problem-solving.

Based on these findings, it is recommended that future studies expand the scope of this research by involving larger and more diverse samples or applying the model across different subject areas to examine its consistency. Considering that this study employed a posttest-only design, future research may adopt a pretest–posttest control group design or mixed-method approaches to obtain a more comprehensive understanding of students' learning development. Further investigations may also explore the impact of this integrated model on other psychological variables, such as self-efficacy and metacognitive awareness, to provide a more holistic perspective on its pedagogical effectiveness.

REFERENSI

Az-Zahra, A., Abdullah, V., & Marini, A. (2023). Studi literatur: Meningkatkan kemampuan pemecahan masalah matematis siswa sekolah dasar dengan model pembelajaran kooperatif tipe Teams Games Tournaments (TGT). *Jurnal Pendidikan Dasar Dan Sosial Humaniora*, *2*(8).

Bernard, M., Nurmala, N., Mariam, S., & Rustyani, N. (2018). Analisis Kemampuan Pemecahan Masalah Matematis Siswa SMP Kelas IX Pada Materi Bangun Datar. *SJME (Supremum Journal of Mathematics Education)*, *2*(2), 77–83.

Dhani, M. I., Aziz, T. A., & Hakim, L. El. (2022). Pembelajaran Matematika Melalui Pendekatan Konstruktivisme. *Jurnal Pendidikan MIPA*, *VOL 12 NO*.

Lanya, H., Zayyadi, M., Sulfiah, S. K., & Roziq, A. (2021). Students' mathematical literacy on the performance of PISA questions: What is gender correlation? *Jurnal Didaktik Matematika*, *8*(2), 222–234. doi:10.24815/jdm.v8i2.20570

Mardaleni, D., Noviarni., & Nurdin, E. (2018). Efek strategi pembelajaran scaffolding terhadap kemampuan pemecahan masalah matematis berdasarkan kemampuan awal matematis siswa. *Juring: Journal for Research in Mathematics Learning, 1(3), 236-241.* http://dx.doi.org/10.24014/juring.v1i3.5668

Mucti, A., & Nurmala R. (2020). Pengaruh Kemampuan Number Sense terhadap Hasil Belajar Matematika Siswa di SMP Negeri 8 Tarakan. *MUST: Journal of Mathematics Education, Science and Technology*, *5*(1), 12–18. https://doi.org/10.30651/must.v5i1.3660

Nurhajati. (2014). Pengaruh Penerapan Pendekatan Konstruktivisme dengan Model Pembelajaran Kooperatif Berbantuan Program Cabri 3D terhadap Kemampuan Penalaran dan Koneksi Matematis Siswa SMA di Kota Tasikmalaya. *Jurnal Pendidikan Dan Keguruan Vol. 1 No. 1, 2014, Artikel 5*.

Nurmala R, Izzatin, M., & Mucti, A. (2019). Desain Pengembangan Buku Saku Digital Matematika SMP Berbasis Android Sebagai Media Pembelajaran Dalam Meningkatkan Minat Belajar Siswa. *Edukasia : Jurnal Pendidikan*, *6*(2), 4–17. http://jurnal.borneo.ac.id/index.php/edukasia/index

Nurmala R, Mulbar, U., & Darwis, M. (2025a). A Design Framework for Mathematics Learning in Junior High School to Improve Students' Mathematical Connection Ability. *International Journal of Education, Vocational and Social Science*, *4*(1), 239–256. https://doi.org/https://doi.org/10.63922/ijevss.v4i01.1508

Nurmala R, Mulbar, U., & Darwis, M. (2025b). *Panduan Desain Pembelajaran In Action pada Pembelajaran Matematika di Sekolah Menengah Pertama* (1st ed.). CV. Ruang Tentor.

Nurmala R, Mulbar, U., & Darwis, M. (2025c). Pembelajaran in Action : Apakah Efektif Meningkatkan Kemampuan Koneksi Matematis Siswa? *Jurnal MATH-UMB.EDU*, *12*(2), 135–141.

OECD. (2019). PISA 2018 Results (Volume

I): What Students Know and Can Do. *OECD Publish*.

OECD. (2021). *PISA 2021 Mathematics Framework (Draft)*.

Panjaitan, S. M., Siallagan, G. P., Sitepu, C., Matematika, P., Keguruan, F., Ilmu, D., & Hkbp, U. (2024). *Analisis Keterampilan Berpikir Tingkat Tinggi terhadap Penerapan Kurikulum Merdeka pada Materi Sistem Persamaan Linear Dua Variabel (SPLDV) Kelas VIII SMP Adhyaksa Medan T . A 2023 / 2024*. *3*, 7046–7060.

Sugiyono. (2014). *Metode Penelitian Pendidikan Pendekatan Kualitatif, Kuantitatif, dan R&D*. Alfabeta.

Wulandari, S. Hermansyah, H., & Pratiwi, Y. I. (2021). The Influence of learning motivation on mathematics learning achievement in terms of gender of class VIII students of SMP Negeri 5 Tarakan. *Journal of Education and Learning Mathematics Research (JELMaR)*, *2*(2), 42–50.