

# Implementation of the Problem Solving Learning Model on the Relationship Between Moles and Mass of Substances in an Entrepreneurial Context

Nur Afni Musir, Army Auliah, Sugiarti

Universitas Negeri Makassar

[afnimusir15@gmail.com](mailto:afnimusir15@gmail.com)

## ABSTRACT

*Chemistry learning that tends to be abstract often leads to low understanding and learning outcomes of students. Therefore, a learning model that is able to connect concepts with real life is needed. This study aims to determine the effect of the application of the Problem Solving model in the context of entrepreneurship on student learning outcomes on the material of the relationship between moles and mass of substances. This study used a quantitative method with a pre-experimental design in the form of a one-group pretest-posttest. The sample of the study was 24 students of class XI of SMA Negeri 1 Tinambung. Data were collected through pretests and posttests, then analyzed descriptively using N-Gain. The results showed that there was an increase in the average score from 49.58 to 78.33, with an increase in learning completeness from 29.17% to 66.67% and an N-Gain value of 0.57 in the moderate category. These findings indicate that the application of the Problem Solving model with an entrepreneurship approach can improve student learning outcomes. Thus, this model can be used as an alternative for more contextual and meaningful chemistry learning.*

**Keywords:** Problem Solving; Entrepreneurship; Learning Outcomes

## ABSTRAK

Pembelajaran kimia yang cenderung bersifat abstrak seringkali menyebabkan rendahnya pemahaman dan hasil belajar peserta didik. Oleh karena itu, diperlukan model pembelajaran yang mampu mengaitkan konsep dengan kehidupan nyata. Penelitian ini bertujuan untuk mengetahui pengaruh penerapan model Problem Solving dalam konteks kewirausahaan terhadap hasil belajar peserta didik pada materi hubungan mol dan massa zat. Penelitian ini menggunakan metode kuantitatif dengan desain pre-experimental berupa one group pretest-posttest. Sampel penelitian adalah peserta didik kelas XI SMA Negeri 1 Tinambung yang berjumlah 24 orang. Data dikumpulkan melalui pretest dan posttest, kemudian dianalisis secara deskriptif menggunakan N-Gain. Hasil penelitian menunjukkan bahwa terjadi peningkatan nilai rata-rata dari 49,58 menjadi 78,33, dengan peningkatan ketuntasan belajar dari 29,17% menjadi 66,67% serta nilai N-Gain sebesar 0,57 dalam kategori sedang. Temuan ini menunjukkan bahwa penerapan model Problem Solving dengan pendekatan kewirausahaan mampu meningkatkan hasil belajar peserta didik. Dengan demikian, model ini dapat dijadikan alternatif pembelajaran kimia yang lebih kontekstual dan bermakna.

**Kata Kunci:** Problem Solving; Kewirausahaan; Hasil Belajar

© 2026 Nur Afni Musir, Army Auliah, Sugiarti  
Under the license CC BY-SA 4.0

## INTRODUCTION

Education is an effort to prepare future generations who are intelligent, wise, and

committed to leading the nation. Law Number 20 of 2003 concerning the National Education System explains that education is an effort to create a learning environment and organized learning activities that enable the development of students' potential, including spiritual strength, self-control, personality, intelligence, noble character, and skills (Bakar & Dauli, 2022).

One form of educational implementation in schools is realized through the learning process in various subjects, including chemistry. Chemistry learning is an effort by teachers to teach chemical concepts and their applications in everyday life. Its implementation requires appropriate strategies, methods, techniques, and learning models to achieve the intended learning objectives (Hamalik, 2008). Chemistry learning also requires a deep understanding of the concepts that have been studied so that they can be retained in students' long-term memory. Therefore, teachers need to select and apply learning strategies, methods, or models that can help students understand chemical concepts effectively and meaningfully. One topic that is often considered difficult is the relationship between moles and the mass of substances, as students are required to understand the relationship among the number of particles, molar mass, and mathematical calculations.

Chemistry instruction at SMA Negeri 1 Tinambung is still predominantly characterized by direct instruction, a teacher-centered learning process in which material is explained systematically by the teacher. This learning model is quite helpful for students in understanding basic concepts because the teacher's explanations are considered easier to follow. However, for topics that require analytical thinking and problem-solving skills, students still tend to depend on examples provided by the teacher. They often encounter difficulties when faced with questions that differ from the examples presented, particularly on topics that demand conceptual understanding as well as computational skills.

This condition indicates that direct instruction needs to be combined with a learning model capable of fostering students' activeness, independence, and problem-solving abilities. One alternative that can be implemented is the Problem Solving model. This model provides students with opportunities to understand problems, plan solution strategies, solve problems, and evaluate the results obtained.

Furthermore, the Problem Solving model is implemented within an entrepreneurial context to make chemistry learning more closely connected to everyday life. Through this entrepreneurial context, students can understand the application of chemical concepts in simple business activities, such as calculating raw material requirements, determining product

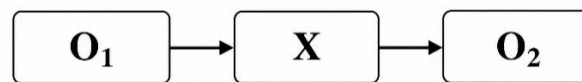
quantities, and estimating production costs. Integrating chemical concepts with entrepreneurial contexts is also expected to foster creativity, independence, innovative thinking, and students' interest in entrepreneurial opportunities from an early age. Thus, students are expected not only to understand the theoretical concepts of the relationship between moles and the mass of substances but also to recognize their practical relevance in real-life situations.

Therefore, this study was conducted to investigate the implementation of the Problem Solving learning model in an entrepreneurial context on the topic of the relationship between moles and the mass of substances at SMA Negeri 1 Tinambung.

## **METHOD**

The method used in this study was a quantitative approach involving one class as the experimental group. The research employed a Pre-Experimental Design, specifically the One-Group Pretest–Posttest Design.

According to Sugiyono (2023), the One-Group Pretest–Posttest Design can be illustrated as follows:



Figur 1. One Group Pretest-Posttest Design

Where:

- $O_1$  = Pretest (measurement conducted before the treatment)
- $X$  = Treatment (implementation of the Problem Solving learning model in an entrepreneurial context)
- $O_2$  = Posttest (measurement conducted after the treatment)

In this design, students are given a pretest before the treatment to determine their initial level of understanding. After the implementation of the treatment, a posttest is administered to measure changes in learning outcomes. The difference between the pretest and posttest scores is used to determine the effect of the treatment on students' learning outcomes.

The variables in this study consisted of an independent variable, namely the implementation of the Problem Solving learning model within an entrepreneurial context, and a dependent variable, namely students' cognitive learning outcomes on the topic of the relationship between moles and the mass of substances. The research sample was Class X1, which was selected using a purposive sampling technique based on the teacher's recommendation.

The research instrument consisted of a cognitive learning achievement test in the form of essay questions administered during both the pretest and posttest. Data were collected through pretests, posttests, and documentation. The research procedure included three stages: the preparation stage, the implementation stage involving instruction using the Problem Solving learning model in an entrepreneurial context, and the final stage, which involved data analysis and drawing conclusions.

The data were analyzed using descriptive statistics to determine students' learning mastery and the improvement in their learning outcomes. The level of improvement was measured using the **Normalized Gain (N-Gain)** score

## **RESULTS AND DISCUSSION**

### **Result**

This study was conducted with 24 students from Class X1 at SMA Negeri 1 Tinambung. Learning outcome data were obtained through a pretest administered before instruction and a posttest administered after the implementation of the Problem Solving learning model within an entrepreneurial context on the topic of the relationship between moles and the mass of substances. The results are presented as follows:

Table 1. Descriptive Statistics of Pretest and Posttest Scores

<b>Statistic</b>	<b>Pretest</b>	<b>Posttest</b>
Total of Sample	24	24
Highest Score	55	90
Lowest Score	20	50
Mean Score	49.58	78.33

Table 1 presents the descriptive statistics of students' pretest and posttest scores. The results show that the mean pretest score was 49.58, while the mean posttest score increased to

78.33. The highest score improved from 55 on the pretest to 90 on the posttest, whereas the lowest score increased from 20 to 50.

These findings indicate an improvement in students' cognitive learning outcomes after the implementation of the Problem Solving learning model within an entrepreneurial context on the topic of the relationship between moles and the mass of substances. The increase in the mean score, as well as the improvement in both the highest and lowest scores, suggests that students demonstrated a better understanding of the concepts following the learning intervention.

Table 2. Learning Mastery in the Pretest and Posttest

Category	Pretest (Frequency)	Pretest (%)	Posttest (Frequency)	Posttest (%)
Mastery	7	29.17%	16	66.67%
Non-Mastery	17	70.83%	8	33.33%

Students were considered to have achieved mastery if they obtained a score of  $\geq 78$ , in accordance with the school's Minimum Mastery Criterion (KKM).

Table 2 shows the learning mastery levels of students before and after the implementation of the Problem Solving learning model within an entrepreneurial context. Prior to the intervention, only 7 students (29.17%) achieved mastery, while 17 students (70.83%) did not meet the minimum mastery criterion (KKM).

Following the implementation of the learning model, the number of students who achieved mastery increased to 16 students (66.67%), whereas the number of students who did not achieve mastery decreased to 8 students (33.33%). This finding indicates a substantial improvement in students' learning mastery after participating in the learning activities.

The increase in the percentage of students achieving mastery from 29.17% to 66.67% suggests that the Problem Solving learning model in an entrepreneurial context contributed positively to students' understanding of the topic of the relationship between moles and the mass of substances. The learning activities provided students with opportunities to actively engage in problem-solving processes and apply chemical concepts in contexts relevant to everyday and entrepreneurial situations, thereby enhancing their cognitive learning outcomes.

Table 5. N-Gain Score

Average N-Gain	Category
0.57	Moderate

Table 5 presents the results of the N-Gain analysis used to measure the improvement in students' cognitive learning outcomes after the implementation of the Problem Solving learning model within an entrepreneurial context. The analysis showed an average N-Gain score of 0.57, which falls into the moderate category.

This result indicates that students experienced a moderate level of improvement in their understanding of the topic of the relationship between moles and the mass of substances. The moderate N-Gain score suggests that the learning intervention was effective in enhancing students' cognitive achievement, as evidenced by the increase in posttest scores compared with pretest scores.

The findings imply that the implementation of the Problem Solving learning model within an entrepreneurial context provided meaningful learning experiences that helped students develop conceptual understanding and problem-solving skills. Through activities that encouraged students to identify problems, formulate solution strategies, and relate chemical concepts to entrepreneurial applications, students were able to achieve a measurable improvement in learning outcomes. Therefore, the learning model can be considered reasonably effective in improving students' cognitive achievement on the topic studied.

## **DISCUSSION**

The findings of this study indicate that the implementation of the Problem Solving learning model within an entrepreneurial context had a positive effect on students' learning outcomes regarding the topic of the relationship between moles and the mass of substances. This is evidenced by the increase in the students' mean score from 49.58 on the pretest to 78.33 on the posttest. Furthermore, the number of students who achieved learning mastery increased from 7 students (29.17%) during the pretest to 16 students (66.67%) during the posttest. These results suggest that the instructional approach applied in this study was effective in improving students' understanding of the subject matter.

The improvement in learning outcomes occurred because the Problem Solving model provided students with opportunities to actively engage in the learning process. Students were not merely recipients of information from the teacher; rather, they were guided to understand problems by identifying relevant information in the given tasks, particularly those related to the concepts of moles and mass within the provided context. During the planning stage, students were trained to select appropriate formulas and organize solution procedures systematically. At the problem-solving stage, students performed calculations independently, thereby enhancing their accuracy and numerical skills. Finally, during the evaluation stage,

students reviewed their solutions, allowing them to identify and correct errors while deepening their conceptual understanding.

These findings are consistent with the study conducted by Nauw et al. (2018), which reported that the implementation of the Problem Solving model effectively improved students' cognitive learning outcomes in chemical bonding, with a class mastery percentage of 88.23%. This result also supports the view of Polya (1973), who argued that problem-solving-based learning develops students' logical, systematic, and critical thinking skills. In learning the relationship between moles and the mass of substances, these stages help students understand how to apply formulas appropriately rather than simply memorizing concepts.

The entrepreneurial context also contributed to improving students' understanding. In this study, learning activities were linked to simple business situations, such as calculating the amount of sugar required for powdered beverage production, determining the number of packages that could be produced, and estimating the efficiency of raw material usage. These activities enabled students to recognize that mole and mass concepts have practical applications in production processes while simultaneously training them to make effective decisions in simple business contexts.

This finding is in line with previous studies on the Chemo-Entrepreneurship approach, which have shown that integrating entrepreneurial elements into chemistry learning enhances meaningful learning experiences and increases the relevance of chemistry concepts to real-life situations (Zakiyah, 2025). According to Suryana (2014), the incorporation of entrepreneurship into learning activities can foster creativity, independence, decision-making skills, and the efficient utilization of resources.

In business activities, accurate raw material calculations are essential for successful production. If the quantity of raw materials is underestimated, production targets may not be achieved. Conversely, overestimating raw material requirements can result in waste and increased production costs. Therefore, understanding the relationship between moles and the mass of substances enables students to accurately calculate material requirements, both in laboratory activities and in the production of simple products that may be developed into entrepreneurial opportunities.

Learning activities that integrate entrepreneurial concepts also enhance students' interest and engagement because the material is connected to real-life situations. Students not only learn theoretical concepts but also gain an understanding of their practical applications in business activities. This finding is supported by previous studies indicating that

entrepreneurship-based chemistry learning has become an important trend in supporting the implementation of the Merdeka Belajar policy and improving students' learning outcomes (Inayah, 2022). Furthermore, other studies have demonstrated that Chemo-Entrepreneurship (CEP)-based learning materials, such as digital e-modules, can significantly increase students' learning interest (Maulida & Kamaludin, 2024).

The present findings are also supported by the study conducted by Saibu et al. (2025), which revealed that the Chemo-Entrepreneurial-Motivated Approach significantly improved students' achievement in practical chemistry learning. This suggests that integrating entrepreneurial contexts into chemistry instruction can serve as an innovative learning alternative that not only enhances academic achievement but also develops students' entrepreneurial awareness and skills.

Overall, the findings of this study demonstrate that the Problem Solving learning model implemented within an entrepreneurial context is a viable alternative for chemistry instruction, particularly on the topic of the relationship between moles and the mass of substances. This model contributes not only to the improvement of students' learning outcomes but also to the development of collaboration skills, accuracy, and entrepreneurial attitudes. With continuous implementation, this learning model has the potential to provide even greater benefits for the quality of chemistry education in schools.

## **Conclusion**

Based on the findings of this study, the implementation of the Problem Solving learning model within an entrepreneurial context on the topic of the relationship between moles and the mass of substances was effective in improving the learning outcomes of Class X1 students at SMA Negeri 1 Tinambung. This was demonstrated by an increase in the students' mean score from 49.58 on the pretest to 78.33 on the posttest. Furthermore, the number of students who achieved learning mastery increased from 7 students (29.17%) to 16 students (66.67%). The N-Gain score of 0.57, which falls within the moderate category, further indicates that the learning model contributed to a meaningful improvement in students' cognitive achievement. Therefore, the Problem Solving learning model implemented within an entrepreneurial context can be considered an effective instructional alternative for enhancing students' understanding of chemistry concepts, particularly the relationship between moles and the mass of substances. The findings suggest that integrating problem-solving activities with entrepreneurial contexts can provide meaningful learning experiences and may serve as an innovative approach to improving both chemistry learning outcomes and students' entrepreneurial awareness.

## REFERENCES

- Bakar., R. A & Dauli., A.F. 2022. *Dasar-Dasar Kependidikan*. Medan: Perdana Publishing
- Hamalik, O. 2008. *Kurikulum dan pembelajaran*. Jakarta: Bumi Aksara.
- Inayah. S. 2022. Systematic review : Pembelajaran Kimia Berbasis Kewirausahaan Untuk Menyongsong Merdeka Belajar. *Proceedings of Life and Applied Sciences*, Volume 2
- Maulida. M. Z & Kamaludin. A. 2024. Development of E-Module Based on Digital Flipbook Maker Containing Chemo-Entrepreneurship (CEP) Chemical Bond Material to Increase High School Student's Interest in Learning. *Jurnal Iqra': Kajian Ilmu Pendidikan*. 9(2): 259–279
- Nauw. J., Parubak. A.S & Suparman. A.R. 2018. EFEKTIFITAS MODEL PROBLEM SOLVING TERHADAP HASIL BELAJAR KOGNITIF PESERTA DIDIK KELAS X4 SMA YPK OIKOUMENE MANOKWARI. (PADA POKOK BAHASAN IKATAN KIMIA) *Arfak Chem: Chemistry Education Journal*. p ISSN 2615-627X, e ISSN 2615-6288
- Polya, G. 1973. *How to Solve It: A New Aspect of Mathematical Method*. Second Edition. Princeton: Princeton University Press.
- Saibu. S.O., Oludipe. O. S., Owolabi. T., Adam. U., Oladejo. I. A., Olude. A.S & Ogundowole. A. 2025. From Theory to Practice: Exploring the Synergy between Chemo-Entrepreneurial-Motivated-Approach and Students' Achievement in Senior Secondary Chemistry Practical. *Journal of Educational Sciences*. 9. (1)
- Sugiyono. 2023. *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Bandung: Alfabet
- Suryana. 2014. *Kewirausahaan: Kiat dan Proses Menuju Sukses* (Ed. 4). Jakarta: Salemba Empat.
- Zakiyah. H. 2025. Development of a Chemo-Entrepreneurship–Based Chemistry Practicum E-Module. *Indonesian Journal of Education and Social Humanities*. 2 (4)