Asian Journal of Community Services (AJCS)
Vol. 5, No. 5 2026: 247-256

Empowering Students in Chemistry Learning through the Implementation of "Chemistry Theater: Transforming Chemistry Learning through Interactive Educational Drama"

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A R T I C L E I N F O

Keywords: Chemistry Theater, Chemistry Learning, Educational Drama, Student Empowerment, Self-Confidence, Creativity

Received : 18, January
Revised : 20, March
Accepted: 22, May

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A B S T R A C T

This community service activity aims to empower students through the implementation of Chemistry Theater, an interactive educational drama-based chemistry learning that integrates chemical concepts with creative and collaborative activities. The activity methods included providing materials, compiling drama scripts, exercises, performances, and evaluation using pretest and posttest questionnaires to measure students' understanding of chemical concepts and self-confidence levels. The results of the activity showed a significant increase in understanding of chemical concepts. Before the activity, most participants were in the low understanding category (52.4%), while after the activity, the majority of participants were in the high understanding category (61.9%). Student self-confidence also increased, indicated by an increase in the high self-confidence category from 19.0% to 71.4%.

INTRODUCTION

Chemistry learning at the secondary school level still faces fundamental challenges related to the scientific nature of chemistry itself. Chemistry is a science that operates at three levels of representation: macroscopic, microscopic (particulate), and symbolic. These three levels must be integrated simultaneously for concepts to be fully understood. In practice, students often experience difficulty connecting these three representations, leading to persistent misconceptions (Islamiyah et al., 2023; Simanjuntak et al., 2024). This difficulty is exacerbated by the abstract nature of chemical concepts, such as atomic structure, chemical bonding, equilibrium, and reaction kinetics. These concepts cannot be directly observed and therefore require strong visualization and mental representation skills. Research shows that this low representational ability contributes to students' low chemistry learning outcomes (Hammer et al., 2018; Ulfah et al., 2024). On the other hand, the learning approach, which is still dominated by lecture methods (Teacher-Centered Learning), limits active student engagement. Traditional learning models tend to position students as passive recipients of information, thus providing little space for exploration, discussion, and independent knowledge construction (Santoso et al., 2024). This condition impacts low learning motivation, interest in chemistry, and critical thinking skills.

Active learning approaches have been proven to increase student engagement and understanding. Active learning emphasizes active student participation through discussions, problem-solving, and collaborative activities. Studies show that this approach significantly improves learning outcomes compared to conventional methods (Apriliani & Panggayuh, 2018; Diani et al., 2018). Therefore, learning innovations are needed that focus not only on knowledge transfer but also on meaningful learning experiences. One potential innovative approach is the use of educational drama in science learning. Educational drama is an arts-based learning strategy that integrates cognitive, affective, and psychomotor elements. Through drama, students can act out scientific concepts through narrative, dialogue, and expression, thus facilitating the internalization of concepts (Blatner, 2009; Tabroni & Sari, 2023).

In the context of chemistry learning, this approach is known as "Chemistry Theater." Chemistry Theater allows students to construct understanding through direct experience, for example by acting out atoms, molecules, or chemical reactions. This approach not only enhances conceptual understanding but also develops communication skills, creativity, and teamwork. Several previous studies have shown that integrating the arts into science learning (STEAM: Science, Technology, Engineering, Arts, Mathematics) can significantly increase student motivation and engagement (Ananda et al., 2023; Febriansari et al., 2022; Kijima et al., 2021; MAHARANI, 2024). Furthermore, the use of drama in science learning has been proven effective in helping students understand complex concepts and improving long-term retention. Indonesian education policy, through the Meaningful Learning Curriculum, also emphasizes the importance of project-based learning, creativity, and character development. The Deep Learning Curriculum encourages students to become creative, critical, and

collaborative individuals (Jamilah et al., 2024; Wulandari et al., 2023). Therefore, the implementation of Chemistry Theater aligns with the direction of national education policy, which emphasizes holistic and contextual learning. Furthermore, the development of scientific literacy is a crucial issue in modern education. Scientific literacy encompasses not only conceptual understanding but also the ability to apply knowledge in everyday life. A drama-based approach allows students to connect chemical concepts to real-life contexts, thereby enhancing their scientific literacy. Therefore, it can be concluded that learning innovations are needed to bridge the gap between abstract concepts and students' understanding. Chemistry Theater presents an alternative solution that integrates active, contextual, and creative approaches in chemistry learning.

IMPLEMENTATION AND METHODS

This community service activity was held at Sandikta Senior High School, Bekasi, targeting high school students. The activity employed a participatory and educational approach through the implementation of Chemistry Theater, an interactive, educational drama-based chemistry lesson that actively engages students in the learning process. The activity was implemented through several stages, as follows:

Preparation Stage

This stage involved coordination with the school regarding the schedule, venue, and selection of participants. The community service team also developed chemistry learning materials to be integrated into the educational drama, prepared learning media, and developed a scenario and implementation guide. Furthermore, students' needs and initial understanding of chemistry were identified through observation and brief discussions with the accompanying teacher.

Socialization and Material Delivery Stage

Students were given an explanation of the basic concepts of Chemistry Theater and the importance of interactive learning in understanding chemistry. Next, the team presented the chemistry material that would be featured in the educational drama, namely the concept of chemical bonds. The material was delivered in a communicative and interactive manner to facilitate students' understanding of abstract concepts. During this socialization stage, the Community Service team was assisted by a chemistry teacher from Sandikta Senior High School, Bekasi.

Educational Drama Training Stage

In this stage, groups are selected and divided based on their roles. The groups are divided into three groups of 6 to 7 people, each playing the role of narrator and atoms, as specified in the drama script. The group division and casting decisions are made by a joint decision between the Community Service Team, students, and the chemistry teacher at Sandikta High School, Bekasi. Participants are given training in basic role-playing techniques, character development, verbal and nonverbal communication, and how to convey scientific concepts through dialogue and drama scenes. During this stage, they are also given the freedom to express themselves according to their assigned roles. The community service team acts as a facilitator and mentor in the drama script development process.

Chemistry Theater Implementation Stage

After the rehearsal, students perform their prepared educational drama in front of other participants and the accompanying teacher. The performance is interactive, allowing for discussion and questions and answers regarding the chemistry concepts depicted in the drama. Through this activity, students not only understand the theory but also learn to relate chemistry concepts to everyday situations in a creative and enjoyable way. 5. Evaluation and Reflection Stage

Evaluation of the activity was conducted through student participatory observation, reflective discussions, and providing feedback regarding the implementation of Chemistry Theater. During this evaluation stage, the assessment also involved a panel of judges consisting of lecturers and teachers (lecturers from the Chemistry Education Study Program and lecturers from the Biology Education Study Program at Widya Mandira Catholic University). The assessment focused on improving students' understanding of chemistry concepts, creativity, communication skills, group work, and enthusiasm during the activity. The evaluation results were used to improve future similar activities

RESULTS AND DISCUSSION

The community service activity was attended by 21 Chemistry Theater participants representing high school students in grades XI IPA F1, XI IPA F2, and XI IPA F3 at Sandikta Bekasi High School. Evaluation was conducted using pretest and posttest questionnaires to measure participants' knowledge levels regarding nutrition and stunting prevention.

Table 1. Level of Understanding of Chemical Concepts Before and After Activities

Understanding Category	Before Activity N (%)	After Activity N (%)
High	7 (14.3)	13 (61.9)
Medium	3 (33.3)	7 (33.3)
Low	11 (52.4)	1 (4.8)
Total	21 (100)	21 (100)

There was an increase in the number of students with a high level of understanding from 14.3% to 61.9%, while the low category decreased from 52.4% to 4.8%.

Table 2. Student Self-Confidence Level Before and After Participating in Chemistry Theater

Category	Before Activity N (%)	After Activity N (%)
High	4 (19.0)	15 (71.4)
Medium	8 (38.1)	5 (23.8)
Low	9 (42.9)	1 (4.8)
Total	21 (100)	21 (100)

Table 3. Activity Evaluation Results Based on Participant Satisfaction Questionnaire

Statement	Before Activity N (%)	After Activity N (%)
Chemistry Theater makes chemistry learning more engaging	21 (100)	0 (71.4)
Chemistry material is easier to understand through drama	19 (38.1)	2 (9.5)
Activities increase public speaking skills	18 (42.9)	3 (14.3)
Activities improve collaboration skills	20 (95.2)	1 (4.8)
Activities enhance student creativity	19 (90.5)	0 (0.00)
Activities should be repeated in the future	21 (100)	0 (0.00)

A total of 21 students participated in the Chemistry Theater activity held at Sandikta High School. Evaluation results showed an increase in their understanding of chemical concepts after the activity. Before the activity, the majority of participants were in the low understanding category (52.4%), while after the activity, the majority of participants were in the high understanding category (61.9%). Furthermore, student self-confidence also increased, as evidenced by an increase in the number of students in the high self-confidence category from 19.0% to 71.4%. The questionnaire results showed that all participants stated that the Chemistry Theater activity made chemistry learning more interesting and worth repeating. Most participants also stated that the educational drama method helped them understand chemical concepts and improved creativity, communication skills, and teamwork. These findings indicate that Chemistry Theater has a positive impact on students' cognitive, affective, and social skills.

Documentation of activities as in Figure 1, 2 dan 3 below:

Figure 1. Activity Documentation (Preparation)

Figure 2. Activity Documentation (Implementation of Chemistry Theater)

Figure 3. Documentation of Activities (Awarding of Best Performance Prizes)

The results of the Community Service (PkM) activity conducted through the application of Chemistry Theater demonstrated that an educational drama-based learning approach positively impacted student learning processes and outcomes. Evaluations revealed an increase in understanding of chemical concepts, self-confidence, communication skills, creativity, and collaboration skills among the majority of participants. These findings suggest that contextualized and interactive chemistry learning can help overcome various obstacles students face in grasping abstract chemical concepts.

The increased understanding of chemical concepts demonstrated by participants after participating in the activity can be explained by the characteristics of Chemistry Theater learning, which actively engages students in the learning process. Before the activity, most students were in the low understanding category (52.4%), while after the activity, the majority of students were in the high understanding category (61.9%). These results demonstrate that representing chemical concepts through drama can help students build connections between macroscopic, submicroscopic, and symbolic concepts, which have historically been a challenge in chemistry learning. When students act out atoms, molecules, chemical bonds, and chemical reactions in scenes and dialogues, they not only memorize concepts but also construct understanding through direct experience.

These findings align with constructivist theory, which emphasizes that knowledge is actively constructed by students through meaningful learning experiences. In this activity, students are directly involved, from understanding the material, constructing the storyline, developing characters, and presenting the performance. This active involvement allows students to process information more deeply compared to lecture methods, which tend to position students as passive recipients of information. Thus, the learning process becomes more meaningful and provides a greater opportunity for the development of strong conceptual understanding.

In addition to improving cognitive aspects, Chemistry Theater has also been shown to increase students' motivation and interest in chemistry. Questionnaire results showed that all participants stated that learning chemistry became more interesting after participating in this activity. This situation indicates that a fun learning environment plays a crucial role in increasing student engagement throughout the learning process. Throughout the activity, students demonstrated high enthusiasm in participating in each stage, from group discussions to the performance. This enthusiasm indicates that this innovative learning approach can create a more positive learning experience than conventional learning.

Increased student self-confidence is also a significant achievement of this activity. The data shows that the number of students with high self-confidence increased from 19.0% before the activity to 71.4% after the activity. This increase can occur because drama activities provide students with the opportunity to perform in front of their peers, deliver dialogue, and express their ideas and understanding openly. The experience of performing in public gradually helps students reduce fear, increase their courage to speak, and build self-confidence. This ability is one of the important skills needed in the learning process and future social life.

The success of this activity also demonstrates the importance of implementing student-centered learning. In Chemistry Theater, students play the role of the primary subjects, actively constructing their own learning experiences. Teachers and the community service team serve as facilitators, providing guidance and support throughout the process. This learning model allows students to take greater responsibility for their learning, enhances active participation, and develops various skills not always acquired through conventional learning.

However, several challenges arose during the implementation of the activity. Chemistry Theater requires a relatively longer preparation, rehearsal, and performance time than traditional learning methods. Furthermore, good coordination between teachers, facilitators, and students is essential for optimal performance. Some students initially expressed shyness and a lack of confidence in performing in public. However, through ongoing guidance and practice, these obstacles were overcome, enabling all participants to actively participate in the performance.

Overall, the results of the activity demonstrate that Chemistry Theater is an effective learning innovation for improving the quality of chemistry learning. This approach not only helps students understand abstract chemical concepts but also enhances learning motivation, self-confidence, creativity, communication skills, and collaboration. Therefore, Chemistry Theater has the potential to be implemented more widely as an alternative to chemistry learning that is creative, interactive, and oriented towards developing students' holistic competencies. The success of this program also demonstrates that integrating science and art can be a relevant strategy in creating more meaningful and enjoyable 21st-century learning.

CONCLUSIONS AND RECOMMENDATIONS

The Community Service (PkM) program, which implemented Chemistry Theater at Sandikta High School, was successfully implemented and had a positive impact on the chemistry learning process. This program successfully integrated abstract chemical concepts into an interactive educational drama, making the material more understandable, engaging, and contextual for students.

Evaluation results showed that Chemistry Theater improved students' understanding of chemistry concepts, as evidenced by the increase in the number of participants with a high understanding category from 14.3% before the activity to 61.9% after the activity. Furthermore, there was an increase in students' self-confidence, communication skills, creativity, and collaboration during the script writing, rehearsals, and drama performances. Most participants also responded positively to the activity, stating that chemistry learning became more enjoyable and easier to understand. Thus, Chemistry Theater can be an effective alternative, innovative learning model to support active, creative, and student-centered chemistry learning. Implementing this method not only contributes to improved learning outcomes but also helps develop 21st-century skills including communication, collaboration, creativity, and self-confidence. Therefore, Chemistry Theater has the potential to be applied sustainably and developed in various chemistry materials and other subjects as an effort to improve the quality of learning in schools.

ACKNOWLEDGMENT

Thank you to the management of Sandikta Bekasi Private High School who have provided a lot of assistance and facilitated the activities so that they can run well and be successful.

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