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Integrating Nationalism in Chemistry Learning Based on Local Products in The Colligative Properties of Solutions

Mengintegrasikan Sikap Nasionalisme dalam Pembelajaran Kimia Berbasis Kearifan Lokal pada Materi Sifat Koligatif Larutan

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ABSTRACT

Chemistry learning in senior high schools (SMA) is seen as abstract and theoretically oriented, making it less contextually meaningful for students. The integration of national values of patriotism and the use of local wisdom in science learning, especially chemistry, is still limited compared to social subjects. This study aims to examine the integration of local wisdom in chemistry learning on the colligative properties of solutions through the practice of making salted eggs (a traditional Indonesian food product) as an effort to foster patriotic character education. The research method used is descriptive qualitative with 34 students of grade XI as subjects. Data were obtained through a response questionnaire and analyzed descriptively in the form of percentages. The results of the study showed an increase in the attitude of patriotism through reflection on local wisdom-based chemistry learning, increasing students' awareness of the scientific and cultural value of local products, encouraging a commitment to be proud of innovating and developing local products that can improve the welfare of the Indonesian people, not just for consumption but also for cultural heritage that can be developed scientifically and economically. The integration of science and culture in this learning was able to increase student involvement in the learning process, facilitate the understanding of chemical concepts, and show the meeting point between understanding chemical concepts and strengthening the character of patriotism, and is in line with the Pancasila Student Profile and the principles of meaningful contextual learning.

Keyword: *local wisdom, colligative properties of solutions, local product-based chemistry learning, character of nationalism*

ABSTRAK

Pembelajaran kimia di sekolah menengah atas (SMA) dipandang bersifat abstrak dan berorientasi pada konsep teoritis, sehingga kurang bermakna secara kontekstual bagi peserta didik. Integrasi nilai kebangsaan cinta tanah air serta penggunaan kearifan lokal dalam pembelajaran sains, khususnya kimia, masih terbatas dibandingkan pada mata pelajaran sosial. Penelitian ini bertujuan untuk mengkaji integrasi kearifan lokal dalam pembelajaran kimia materi sifat koligatif larutan melalui praktik pembuatan telur asin (produk pangan tradisional Indonesia) sebagai upaya menumbuhkan pendidikan karakter cinta tanah air. Metode penelitian yang digunakan adalah deskriptif kualitatif dengan subjek sebanyak 34 siswa kelas XI. Data diperoleh melalui angket respon dan dianalisis secara deskriptif dalam bentuk persentase. Hasil penelitian menunjukkan peningkatan sikap cinta tanah air melalui refleksi terhadap pembelajaran kimia berbasis kearifan local, meningkatkan kesadaran siswaterhadap nilai ilmiah dan budaya produk lokal, mendorong komitmen untuk bangga berinovasi mengembangkan produk-produk local yang dapat mensejahterakan penduduk Indonesia bukan sekadar konsumsi tetapi warisan budaya yang dapat dikembangkan secara ilmiah dan ekonomi. Integrasi sains dan budaya dalam pembelajaran ini mampu meningkatkan keterlibatan siswadalam proses pembelajaran, mempermudah pemahaman konsep kimia, serta menunjukkan titik temu antara pemahaman konsep kimia dan penguatan karakter cinta tanah air, serta selaras dengan Profil Pelajar Pancasila dan prinsip pembelajaran kontekstual yang bermakna.

Kata kunci: *kearifan local, sifat koligatif larutan, pembelajaran kimia berbasis produk local, karakter cinta tanah air*

Introduction

Chemistry learning in senior high schools (SMA) is often seen as abstract and oriented towards mastering theoretical concepts, thus providing less real contextual meaning for students. Microscopic and symbolic chemical concepts require extra effort to be linked to students' daily experiences, because they are often only learned through textbooks without real contextualization in their lives. Learning that is too abstract and does not link the material content to students' social and cultural environments tends to make them less motivated and less actively involved in the learning process. This is a challenge that needs to be overcome in contemporary science education and this can be one of the reasons why students experience difficulties in understanding the content of chemistry material comprehensively (Islawati & Trisnawati Arwien, 2025).

This learning environment, which is predominantly focused on cognitive aspects, often results in low student engagement and minimal internalization of character values such as patriotism, cultural awareness, and social responsibility. Character education is a priority in the Indonesian education system. Values such as discipline, responsibility, and especially patriotism need to be instilled from an early age so that the younger generation can develop a strong sense of identity and pride in their nation and country (Sholawati Nova et al., 2024). One factor contributing to the decline in patriotism is the negative influence of Western culture entering Indonesia. Global forces impact educational development, and the state must be able to foster nationalism in its citizens to cope with change (Davies et al., 2017). If this situation is allowed to continue, it is feared that students will lose their understanding of the Indonesian nation and its rich culture, which could lead to a lack of patriotism. On the other hand, Indonesia possesses an abundance of local wisdom that has great potential to be used as a context for science learning. Various educational studies have shown that local wisdom can be used as an authentic learning resource, making learning more contextual, meaningful, and closer to students' daily lives. The ethnoscience approach, for example, shows that integrating local community knowledge with scientific concepts can improve student understanding and engagement in chemistry learning (Alqadri, 2025).

One form of local wisdom closely related to students' experiences is making salted eggs, a traditional practice common in various regions of Indonesia. The process of making salted eggs involves a scientific phenomenon relevant to the concept of osmotic pressure in the colligative properties of solutions, namely the movement of solvent and solute particles through a semipermeable membrane due to differences in solution concentration. This practice offers students the

opportunity to directly observe scientific principles that are usually considered abstract (Wibowo & Ariyatun, 2020). To increase the relevance of learning and student participation, a contextual approach by integrating real-life contexts and local products can be interesting. Material such as the colligative properties of solutions is often faced by students as difficult because of its microscopic and conceptual nature. Teachers can explicitly link the material to everyday phenomena, for example, the preservation or soaking process involving salt solutions. One of Indonesia's typical local products is salted eggs, which are very relevant to the concept of colligative, where the salting process involves the principles of saturated solutions, diffusion, and osmotic pressure (Ulupi et al., 2015). Through the salted egg making practicum, students not only learn chemical concepts but also realize the cultural and economic value of potential local products, so that learning is not only cognitive but also affective, strengthening the attitude of love for the homeland.

The role of teachers is crucial in the process of developing student character, meaning they must possess professional qualifications and specialized skills in learning to create an effective learning process. The most important factor in achieving educational goals is learning strategy: encompassing approaches, methods, and learning models selected and designed according to student needs (Nuriyah et al., 2025). In line with character formation, other research shows that learning media based on local wisdom can enhance students' sense of belonging to local culture as part of their national identity, ultimately contributing to strengthening their nationalism and strengthening students' moral character and national values in the context of formal learning in accordance with the applicable curriculum (Irvan & Mustadi, 2021). Integrating local wisdom practices such as making salted eggs into chemistry lessons has the potential to not only enhance understanding of scientific concepts but also help instill a sense of pride in local products as a manifestation of students' love for their homeland. Learning that links local culture with science allows students to appreciate the richness of traditions while helping internalize character values contextually (Mulyani & Julianto, 2018).

Local wisdom-based learning has been widely studied in previous research literature, demonstrating its effectiveness in improving students' conceptual understanding and learning motivation. Several studies confirm that local wisdom-based learning plays a role in shaping national character. For example, research shows that local wisdom-based learning strategies are effective in fostering a sense of nationalism through the integration of folklore, traditional games, and cultural rituals into character education activities (Rinovian R et al., 2025). Furthermore, a literature review found that local wisdom has great potential in enhancing students' patriotism, especially when traditional values, regional languages, and cultural heritage are used as contextualization in the learning curriculum (Putri & Lestari,

2024). A systematic review of local wisdom-based learning strategies shows that integrating cultural practices into learning can significantly increase student engagement and conceptual understanding, and culture-based character education can foster students' moral values and nationalism (Araújo et al., 2022). However, the aspects of national values and love of the homeland, especially in chemistry learning, are still rarely studied specifically, due to the lack of research that integrates local wisdom explicitly in chemistry learning in high schools, limited studies that link concrete chemical practices such as osmotic pressure with strengthening the value of love of the homeland, there are not many studies that examine students' perceptions of chemistry learning based on local wisdom as a medium for character education and nationalism. This study is here to fill this gap by examining further how the integration of local wisdom in chemistry learning can support the formation of students' nationalistic character. Based on the background above, the problems identified in this study include:

1. Chemistry learning is not optimal in linking scientific concepts to students' local culture, so the learning material feels distant from their real-life experiences.
2. The value of patriotism has not been contextually internalized in science learning, as the learning approach remains theoretical and lacks a connection to pride in national culture.
3. Local wisdom is still frequently used in social and humanities subjects, while its use in science learning, particularly chemistry, is still limited.
4. There has been no research integrating local products into learning about colligative properties to foster nationalism.

Thus, this study aims to examine the integration of nationalism character of love for the homeland to chemistry learning based on local wisdom: analyzing student responses to chemistry learning based on making salted eggs integrated with the concept of osmotic pressure, describing the role of such learning in fostering students' love for the homeland through internalization of local cultural values, and examining students' perceptions of preserving local wisdom through chemistry learning as a medium for character education. Science learning that integrates local culture has been proven to help shape students' character more meaningfully because the context is appropriate to their social life (Djarwo & Amsad, 2025). This kind of approach not only strengthens the understanding of scientific concepts, but also integrates character education, especially love for the homeland, in chemistry learning, which is rarely the focus of research explicitly on the material of colligative properties of solutions with a focus on nationalism character.

Research Methods

This study uses a qualitative descriptive approach to systematically and objectively describe students' responses to local wisdom-based chemistry learning through making salted eggs on the topic of colligative properties of solutions, especially osmotic pressure. This method allows researchers to present data in the form of numbers and percentages in collecting data on students' perceptions and responses after participating in local wisdom-based chemistry learning. This study does not compare treatments between groups, but rather focuses on describing students' responses to the learning that has been implemented. The subjects in this study were 34 grade XI students at SMAN 1 Banyusari who had participated in chemistry learning on the topic of colligative properties of solutions with the context of making salted eggs. The selection of subjects was based on the suitability of the learning material with the characteristics of grade XI students and the relationship between the concept of osmotic pressure and the practice of local wisdom applied. Qualitative data analysis in this study used the Miles and Huberman interactive model, which includes the stages of data reduction, data presentation, and conclusion drawing and verification. Data reduction was carried out by sorting and focusing data relevant to the research objectives. Next, the data were presented in the form of narrative descriptions and tables to facilitate the analysis of patterns and findings. The final stage, namely drawing conclusions, was carried out continuously along with verification to ensure the validity and consistency of the research results (Miles et al., 1992). The instrument used in this study was a student response questionnaire compiled using a Likert scale. The questionnaire covered several aspects, namely: Understanding the concept of colligative properties of solutions (osmotic pressure), Student motivation and involvement in learning, Perceptions towards the preservation of local wisdom, and Love for the homeland. Data obtained from the questionnaire were analyzed using percentage analysis. Each student response was calculated and converted into a percentage to determine the tendency of answers in each response category. The results of the analysis were then interpreted based on the response categories (strongly agree, agree, disagree, and strongly disagree) to obtain a general picture of student responses to the applied learning.

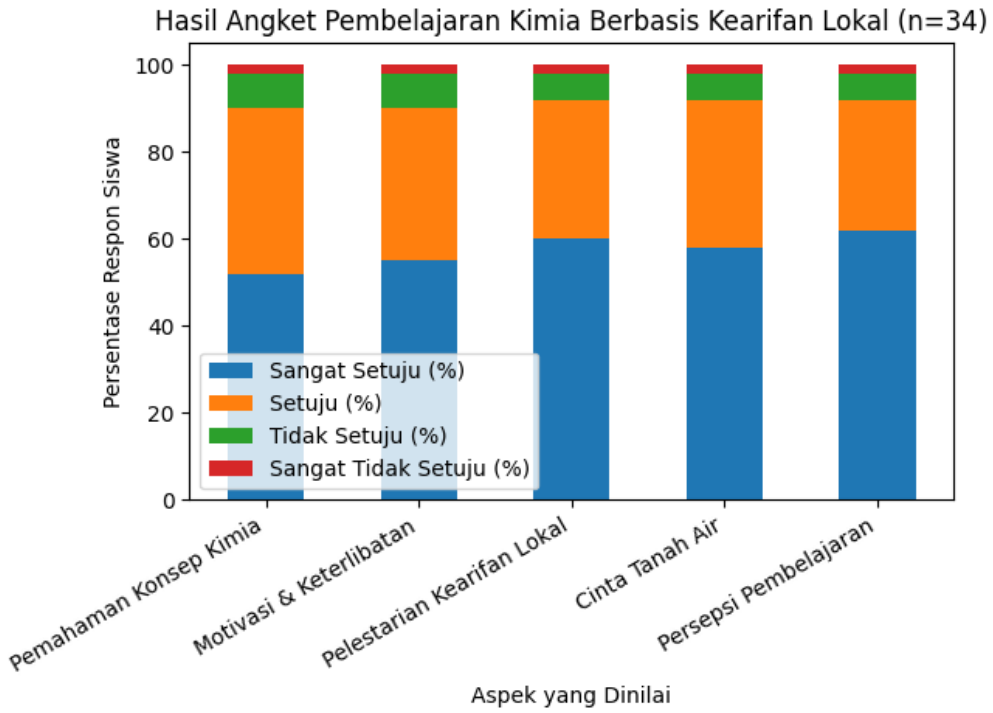
Results and discussion

Local wisdom is a form of national cultural identity that develops and is passed down through the lives of local communities. Local wisdom not only reflects cultural values but also encompasses knowledge, skills, and practices that emerge from the interaction of communities with their environment. Therefore, the

introduction and preservation of local wisdom play a crucial role in shaping students' character, particularly in fostering a sense of patriotism ((Lubis et al., 2017). Teachers play a crucial role in fostering this sense of patriotism in students. Instilling it through education and teaching can guide students to appreciate the history, culture, traditions, and heritage of a nation through engaging and interactive learning, which can foster a greater appreciation for the nation's richness and diversity. Local wisdom-based chemistry learning is implemented through several stages, as follows:

1. Chemistry Learning Planning Based on Local Wisdom: At this stage, researchers developed chemistry learning materials that integrated the concept of osmotic pressure with the practice of making salted eggs as a form of local wisdom. The planning included developing learning objectives, teaching materials, learning steps, and assessing the instillation of patriotism through the introduction of local products.
2. Learning Implementation and Practice: This stage involved classroom learning that combined an explanation of the concept of colligative properties of solutions with the practical activity of making salted eggs. Students were actively involved in practical activities and discussions to observe the phenomenon of osmosis and relate it to the concept of osmotic pressure.
3. Learning Reflection: After the learning and practical activities, students are invited to reflect on the relationship between the chemistry concepts they learned and the local wisdom practice of making salted eggs. This reflection aims to strengthen conceptual understanding while internalizing cultural values and patriotism.
4. Student Questionnaire: In the final stage, students are asked to complete a questionnaire responding to the learning that has been implemented. This stage is crucial for uncovering student perceptions regarding conceptual understanding, learning motivation, preservation of local wisdom, and fostering patriotism, so that the process of internalizing values can be systematically identified.

This study involved 34 eleventh-grade students who had participated in a local wisdom-based chemistry lesson on making salted eggs, focusing on the colligative properties of solutions (osmotic pressure). The following is a summary of the percentage of student responses to each aspect studied.



Assessed Aspects	**SS (%)**	**S (%)**	**TS (%)**	**STS (%)**
Understanding of Chemistry Concepts	52	38	8	2
Motivation & Engagement	55	35	8	2
Preservation of Local Wisdom	60	32	6	2
Love of the Country	58	34	6	2
Perception of Learning	62	30	6	2

Keterangan:
SS = Sangat Setuju, S = Setuju, TS = Tidak Setuju, STS = Sangat Tidak Setuju

The questionnaire results showed that 90% of students (SS + S) stated that learning to make salted eggs helped them understand the concept of osmotic pressure. This shows that contextualizing chemical concepts through local wisdom is able to connect abstract theories with real phenomena. This learning facilitates students to understand that the process of entering salt solution into eggs is a form of osmotic pressure application, so that the concept of colligative properties of solutions becomes more meaningful. As many as 90% of students gave a positive response to the motivation and engagement aspects. The direct practice of making salted eggs encouraged students to be more active in discussions, more enthusiastic

about participating in learning and increased curiosity. This is in line with the characteristics of 21st-century learning that emphasizes student-centered learning and direct experience. The aspect of Preserving Local Wisdom received the highest response of Strongly Agree (60%). Students realized that salted eggs are a traditional food product that has scientific and cultural value. This learning serves as an educational tool in preserving local wisdom through integration into chemistry subjects. Meanwhile, in the aspect of Strengthening Love for the Country, 92% of students agreed that this learning fostered a sense of pride in local Indonesian products. This shows that chemistry learning not only functions to master concepts, but also as a medium for internalizing the values of nationalism and love for the country. The perception aspect received the most positive response with 92% of students agreeing and strongly agreeing that this learning is interesting and worth applying to other chemistry materials. This shows that the local wisdom-based learning model has the potential for sustainability and high relevance in the curriculum. This study provides a bridge between science, local culture, and character education. Integrating local products in chemistry learning is in line with the efforts of the "Independent Curriculum" and national character education, which emphasize meaningful and contextual learning (Novan Prasetya & Munfarikhatin, 2025).

The implementation of local wisdom-based chemistry learning has results that can be seen in terms of conceptual understanding (students are able to connect practical observations with the concepts of osmosis and colligative properties), the character of patriotism (there is an increase in awareness and pride in local products, showing interest in promoting/developing salted eggs more scientifically), and science process skills (improved skills in designing experiments, collaboration, and scientific reporting). Thus, it can be concluded that local wisdom-based chemistry learning through making salted eggs is able to: improve understanding of the concept of osmotic pressure, increase student motivation and involvement, contribute to the preservation of local wisdom, strengthen students' sense of patriotism and get a very positive response from students.

1.1 Local Wisdom-Based Chemistry Learning for Understanding the Concept of Colligative Properties of Solutions

Observations and interviews showed that students participating in this practicum improved their understanding of the concept of colligative properties, explaining how salt solutions affect osmosis, vapor pressure, and the results of salting eggs. Furthermore, through reflection, many students expressed pride in learning that salted eggs are a regional specialty and realized that chemistry can be used to understand and develop local potential. Thus, students gained a real-world,

contextual learning experience that was close to their daily lives. The predominance of agree and strongly agree categories indicated that the salted egg-making practicum helped students connect the abstract concept of colligative properties of solutions with real-life phenomena.

One concrete example of the application of colligative properties of solutions in everyday life is the process of making salted eggs, which uses osmotic pressure. Osmotic pressure is the pressure that arises due to the difference in solute concentration between two solutions separated by a semipermeable membrane. In the context of making salted eggs, a salt solution with a higher concentration than the inside of the egg causes the movement of substances through the pores of the semipermeable eggshell. The process of immersing the egg in the salt solution allows students to directly observe the mechanism of osmosis, namely the movement of solvent and solute due to differences in osmotic pressure. The higher the concentration of the salt solution used, the greater the osmotic pressure produced, thus accelerating the process of salting the egg. This phenomenon is in line with the concept of osmotic pressure, which is theoretically influenced by the number of solute particles in the solution. Furthermore, it provides students with hands-on experience with the movement of solvents and solutes through semipermeable membranes due to differences in concentration. Thus, the concept of osmotic pressure is understood not only theoretically but also through empirical observation. This reinforces meaningful learning as students build knowledge based on direct experience, helping them not only understand local culture but also appreciate and preserve it as part of their national assets, thus fostering a sense of pride and love for their homeland (Zakiyah et al., 2022). This finding aligns with the principles of contextual learning, which emphasize the connection between learning materials and students' real-life experiences. Contextual learning has been shown to enhance conceptual understanding because students can see the relevance between chemical theory and its application in everyday life (Satriawan et al., 2017).

Learning is designed to link the concept of colligative properties of solutions with the process of salting local breast milk eggs with several concentrations, as well as observing physical changes (color, texture) and chemical (salt content) this is in line with previous research which shows that variations in salt solution concentration affect the salt content in salted eggs to the osmotic pressure process as a colligative property of the solution (Ulupi & Indriani, 2015). Salted eggs undergo an osmosis process, namely the movement of water molecules through a semipermeable membrane from a hypotonic solution (low concentration) to a hypertonic solution (high concentration), the salt solution enters the egg through the pores of the egg shell so that the egg can produce a salty taste. Based on class observations and analysis of project assignment reports, students are able to link the observed phenomena (changes in egg mass, yolk texture, saltiness level) with the mechanism of osmosis and diffusion of Na^+/Cl^- ions through the egg shell/pores, the core concept of colligative properties (solvent/solute movement, osmotic pressure). Students can also explain the difference in results between concentrations as a result of the concentration gradient that changes the rate of diffusion/osmosis. These findings align with the results of PjBL research and product-based/natural product practicum projects that show an increase in conceptual understanding and science process skills when students work on real projects (laboratory projects/natural product projects) (A. Hakim et al., 2016). From the product side, student experimental documentation (photos, organoleptic notes, and simple measurements) has shown good results, in line with technical studies reporting that certain temperature treatment concentrations can produce saltiness and quality levels that meet certain organoleptic standards; the duration of soaking also affects salt penetration (Yassa et al., 2023). Student creativity and innovation are needed to reflect the value of local products, local economic potential, and their role as the next generation who appreciates the nation's wealth, to create, become entrepreneurs and understand the application of chemistry in everyday life, this is related to chemoentrepreneurship (Dewi & Mashami, 2019).

1.2 Integrating the Concept of Colligative Properties of Solutions through the Local Wisdom of Salted Egg Production in Chemistry Learning

The production of salted eggs is a practice of local wisdom that has developed in Indonesian society and has been passed down from generation to generation. Salted Eggs, as a Representation of Indonesian Local Wisdom, are a traditional Indonesian food product that: Develops from local community knowledge, utilizes local natural resources (duck eggs, salt), and is produced through traditional processes passed down through generations. In an educational context, utilizing salted eggs as a learning context means bringing national culture

into the classroom, so that students not only learn scientific concepts but also recognize and appreciate their country's local products. In making salted eggs, students learn about osmotic pressure, the transfer of substances through semipermeable membranes, and the colligative properties of solutions.

In this learning, local wisdom serves not only as a contextual example, but also as an authentic learning resource. The integration of salted egg making into chemistry learning demonstrates that local culture is closely linked to modern scientific concepts. When modern chemical concepts are explained through traditional Indonesian practices, the following occurs: Recognition that science is inseparable from national culture. This builds intellectual pride that: Local products have a scientific basis National culture is not merely a tradition, but the result of empirical knowledge. This is the intersection of science and nationalism. The results of the study indicate that students are increasingly aware that traditional food products such as salted eggs have a scientific basis, particularly in the concept of osmotic pressure. This awareness fosters an understanding that science is not separate from community culture, but rather develops from pre-existing local practices. Thus, local wisdom-based chemistry learning plays a role in bridging scientific knowledge with local culture. This addresses the gap in previous research that is still limited in explicitly integrating local wisdom in science subjects, especially chemistry.

Colligative properties of solutions are properties of solutions that depend on the number of solute particles, not on the type of solute. Making salted eggs provides a concrete example of the application of colligative properties of solutions because the process is influenced by the concentration of the salt solution used. In this practice, students can observe that differences in solution concentration directly affect the final salted egg product. Through this activity, students understand that the local wisdom of making salted eggs has actually applied chemical principles for a long time, although traditional communities do not scientifically refer to it as osmotic pressure. This understanding fosters awareness that chemistry is not separate from community culture, but rather develops from pre-existing local practices. Thus, chemistry learning based on local wisdom not only serves as a means of understanding the concept of colligative properties of solutions, but also as a bridge between modern science and traditional community knowledge.

1.3 Local Wisdom-Based Chemistry Learning to Cultivate Love for the Country (National Character)

Local wisdom-based chemistry learning, particularly regarding the colligative properties of solutions in the osmotic pressure egg-making lab activity, can be strongly and validly viewed as fostering love for the country through local

wisdom, provided it is implemented consciously, planned, and reflectively in the learning design. The mechanism for fostering love for the country in this learning is evident through three main aspects, which are affective indicators of love for the country in character education:

1. Awareness (Cognitive Awareness): Students recognize that local Indonesian products have scientific and cultural value relevant to modern science.
2. Appreciation (Affective Domain): Students are proud of local food products and respect local traditions.
3. Commitment (Behavioral Intention): Students are encouraged to preserve local wisdom. They value local products over foreign products.

The results of this study indicate that local wisdom-based learning positively contributes to fostering students' patriotism. The integration of the concept of osmotic pressure through the production of salted eggs also contributes to fostering patriotism in students. When students understand that traditional Indonesian food products have a strong scientific basis, a sense of pride emerges in the nation's culture and local wisdom, which are worthy of being protected and preserved. This learning demonstrates that instilling patriotism does not have to be done normatively or verbally, but can be internalized through contextual and meaningful learning experiences. Chemistry learning that emphasizes local practices such as making salted eggs provides a learning experience that is not only cognitive, but also affective. Thus, making salted eggs in chemistry learning can be seen as a form of internalization of patriotism that is carried out contextually and meaningfully, rather than through a purely normative approach. The increase in affective skills is indicated by many students expressing pride, wanting to learn more about local salted egg production technology, and feeling called to promote or develop local products. Activities that connect science with local stories (the origins of salted eggs in the region, local home industries) encourage students to view local products not merely for consumption but as cultural heritage that can be developed scientifically and economically. These findings are reinforced by studies of integrating local wisdom into PjBL/learning modules, which show that linking academic material to local culture can foster national identity and learning motivation. Recent science education articles recommend incorporating local wisdom as an effective strategy for strengthening character and science contexts (F. Hakim, 2024). Through chemistry learning that implements the instillation of nationalistic character of love for the homeland, students can grow as intelligent, moral, and characterful human beings. The attitude of love for the homeland can be demonstrated by loving domestic products. Loving domestic products means buying, using, and utilizing products made by local Indonesian companies or business groups is a form of nationalism and a form of embodiment of national defense in the current global era,

making students proud of Indonesia and eroding attitudes that can cause division (Rafif Kurniawan et al., 2025). Another encouraging thing is as a National Education Foundation that is in line with Indonesian education policies, including: Pancasila Student Profile (global diversity), Strengthening Character Education, contextual and culture-based learning.

The implementation of instilling nationalism values in other chemistry learning activities can be shown when the formation of group members is carried out fairly, no one is discriminated against, respecting each other, learning activities that insert nationalist character values for love of the homeland, not destroying nature, learning culture, being proud to use and innovate to develop local products that can improve the welfare of the Indonesian people. Local wisdom passed down from generation to generation is a form of manifestation of love for the homeland. The process of making salted eggs involves methods learned from ancestors, which are then maintained until now. This demonstrates the importance of preserving local traditions and identity as part of a community's identity. This philosophy emphasizes that technological advances and modernity do not have to erase traditions, but can actually enrich local culture if properly integrated. Historically, salted eggs have thrived due to the community's openness to innovation. In addition to extending the egg's shelf life, over time, the community has developed various variations of salted eggs, such as grilled salted eggs and salted eggs with various flavors. This demonstrates that while maintaining tradition, people are also able to adapt and be open to change and developments. This philosophy is crucial in modern life, where adaptation is key to success in various aspects.

Conclusion

This research fills a gap in research that has been limited, particularly regarding the integration of local wisdom in chemistry learning that integrates the concept of colligative properties of solutions and osmotic pressure, with the development of patriotism through local wisdom. The results of the study indicate that learning to make salted eggs is not only effective in helping students understand the chemical concept of colligative properties of solutions, but also plays a role in strengthening students' nationalistic character. By linking science to the local cultural and economic context, students not only learn theory but also appreciate and feel proud of their nation's wealth. Direct involvement in practical activities close to their lives makes them more active and enthusiastic in participating in learning. This positive perception indicates that the use of local wisdom as a learning context can increase learning motivation while strengthening understanding of chemical concepts. This learning is considered relevant to be applied to other chemistry materials that are related to daily life and local culture. This research expands the study of local wisdom-based learning, which was

previously more applied to social subjects, to be relevant and applicable in science learning. These findings reinforce the view that local wisdom-based learning has significant potential to be developed as an alternative learning model in chemistry and plays a strategic role in character education through its utilization as a learning model aligned with the direction of 21st-century science education transformation. However, this study has limitations, including its focus on a single context of local wisdom and a single chemistry topic, thus limiting the generalizability of the findings. Furthermore, the strengthening of patriotism in this study is based on students' perceptions during the learning process, so further studies are needed to strengthen the findings in different contexts and materials.

Suggestion

Based on the findings and limitations of this study, it is recommended that further research develop and use a more comprehensively validated instrument for measuring patriotism or love of country, so that the strengthening of character education in chemistry learning can be measured more objectively and consistently. In addition, further research needs to expand the context of local wisdom to other regions and examine its application to different chemistry topics, in order to obtain a broader picture of the effectiveness of local wisdom-based chemistry learning in fostering student nationalism. From the learning practice perspective, it is recommended to: design chemistry learning that is integrated with local culture in a planned and reflective manner, and supported by the development of contextual teaching materials; have support facilities and collaboration with local industry players/stakeholders so that local product-based learning can be implemented optimally and sustainably; use quasi-experimental methods or experiments with a control group to quantitatively measure the effect of local product-based learning on attitudes of love of country and student learning outcomes. Such a design is worthy of being recommended for wider development in various contextual chemistry topics, as a learning model that is in line with the direction of the transformation of 21st-century science education.

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