

# Acceptability and Development of Chemistry Lessons Integrating Conceptual Change Argument-Driven Inquiry (CCADI)

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**Abstract** The integration of inquiry-based learning within classroom instruction is increasingly prevalent due to its potential to enhance students' critical thinking abilities while facilitating an engaging learning experience. This study aimed to develop lessons that incorporate conceptual change argument-driven inquiry activities, and to assess their acceptability based on criteria including content, format, presentation, and organization, as well as the accuracy and currency of information. Employing a Research and Development (R&D) methodology, the objective was to produce effective instructional materials that enhance lesson development through the integration of these inquiry activities. The findings indicate that the average scores for the respective evaluation criteria were 3.77 for content, 3.51 for format, 3.43 for presentation and organization, and 3.49 for accuracy and currency. These scores suggest a high level of acceptance across all criteria. Consequently, the developed lessons are deemed suitable for implementation in senior high schools, specifically within grade 11 chemistry courses. Furthermore, these lessons are designed to promote essential 21st-century skills. Educators are strongly encouraged to incorporate the argument-driven learning method into their pedagogical practices, as it has been recognized for its enjoyable, engaging, and learner-centered approach.

**Keywords:** chemistry lessons, conceptual change, argument-driven inquiry

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## 1. Introduction

Learning may entail changing one's concepts and adding new information to what is already known [1,2]. This perspective was developed using the idea of conceptual change learning. The conceptual change model comprises two key components [3]. The first is the set of circumstances that must be satisfied for a person to undergo a conceptual shift. The amount of conception that fulfills requirements is referred to as a person's conception status. The higher the rank of a conception, the more requirements it satisfies. The second component is the person's conceptual ecology, which provides the context for a conceptual shift to occur, impacts the change, and offers meaning to the change. According to the conceptual change model, a person's conceptual ecology encompasses various types of knowledge, including epistemological commitments to consistency and generalizability, metaphysical beliefs about the world, and analogies and metaphors that facilitate new data organization [4]. A person's conceptual ecosystem is important in establishing the state of their conception, as it informs their judgments

about whether the requirements for conceptual change have been met [5]. Some criteria for teaching conceptual change are concepts, metacognition, status, and justification [6]. Teachers should openly address students' ideas in instruction based on the conceptual change paradigm — a practice that is not frequently observed. Another concern is that students' views should be treated equally with the teacher's [7]. This helps learners choose between several viewpoints during classroom discussions. Furthermore, several learning tools are utilized by teachers in their classroom discussions.

The Argument-Driven Inquiry (ADI) learning model is designed to create a classroom environment that supports learners in understanding how to formulate a scientific explanation, generalize scientific facts, and use data to answer scientific questions [8]. Additionally, students must gather data by conducting an experiment and engaging in an argumentative discussion phase [9]. Several learning methods can develop the skills demanded in the 21st century; one of them is argument-driven learning [10]. A study conducted on the effects of ADI on argumentation skills showed significant results that are more effective in improving the quality of students' scientific argumentation skills during learning [11].

Furthermore, applying the inquiry approach within the classroom can help students improve their critical thinking, reasoning, and conceptual understanding, as it integrates with scientific argumentation [12]. With the guidance of teachers, learners can practice scientific argumentation to enhance their understanding of scientific phenomena through asserting, arguing, and providing evidence to support their claims and arguments [13]. With this, inquiry instruction can emphasize scientific argumentation to enhance students' understanding of science [14]. The connection between the inquiry approach and argumentation constituted the argumentation-driven inquiry (ADI) teaching model, which is the focus of this study. The reason for the significant change in students' conceptual understanding when using ADI is that it presents an opportunity for learners to explore information and use critical reasoning [15]. In ADI, students need to plan experiments, gather supporting information, and assess and interpret the results to develop their skills in experimental investigations [16]. With the activities prepared by the teacher, students construct new knowledge based on previous learning and validate their claims with evidence from experiments. The ADI approach assists teachers and students in using questions to expand their thinking and organize knowledge [17].

Moreover, the different emphases on conceptual change studies have drawn attention to physics-related concepts [18,19,20,21] and biology-related concepts [22,23]. However, there is relatively limited attention to chemistry-related studies [24,25,26], which underscores potential disparities in science education research priorities. Balancing the exploration of conceptual change across various scientific domains could contribute to a more comprehensive understanding of the learning process in Chemistry. Despite the incorporation of a diverse array of teaching strategies in the conceptual change study, ranging from constructivism [27] and computer simulation-assisted instruction [28] to direct instruction models [29], conceptual change integrated with advance organizers [30], conceptual change combined with the predict-observe-explain strategy [31], concept mapping and guided discovery [32] there are no related studies that focused on the improvement of students' scientific argumentation skills.

The study focuses on the development and acceptability of Chemistry lessons that integrate conceptual change and argument-driven inquiry to enhance learners' comprehension of reaction rates. It intends to integrate the principle of conceptual change argument-driven inquiry (CCADI). With the aid of ADI, students are encouraged to formulate questions, investigate, develop evidence-based arguments, and think critically about science activities

[33]. The essence of examining the chemistry curriculum in reaction rate concepts can provide a solid foundation for students to understand phenomena and processes in the chemical state.

The conceptual change argument-driven inquiry (CCADI) is a pedagogical approach that integrates argumentation and inquiry-based learning to facilitate conceptual understanding in science education. The approach is centered on the concept that learning is most effective when students actively develop, assess, and defend scientific arguments based on data gathered in hands-on activities or experiments. However, there is a need to improve 21st-century skills among students, particularly in critical thinking and problem-solving related to science concepts. One way to enhance learning in science, particularly in chemistry, is to utilize the inquiry method. Learning science must develop students' abilities to understand and apply scientific reasoning in argumentation contexts. Thus, to advance teaching strategies in conceptual change, it is essential to integrate the Conceptual Change Argument-Driven Inquiry (CCADI) model, a framework designed to transform conventional classroom practices into instructional learning that provides students with opportunities to engage in reflective scientific inquiry.

## 2. Methodology

This study employed a Research and Development (R&D) method. Research and development aim to produce a product that integrates lessons with conceptual change argument-driven inquiry. Conceptual change refers to how pre-existing misconceptions are replaced by empirical information. It is measured by assessing the student's ability to explain the reaction rate before and after the intervention using conceptual change argument-driven inquiry. In contrast, argument-driven inquiry – refers to the teaching approach of scientific argumentation and inquiry-based learning. It engages students in generating, analyzing, and debating scientific arguments based on the findings from experiments on reaction rates and collision theory. The resulting product is then evaluated for its acceptability based on content, format, presentation, organization, accuracy, and the inclusion of up-to-date information, as adapted from the Department's Learning Resources Management and Development System (LRMDS) rating sheet [34]. The stages of developing the lessons integrated with conceptual change argument-driven inquiry are summarized in Figure 1.

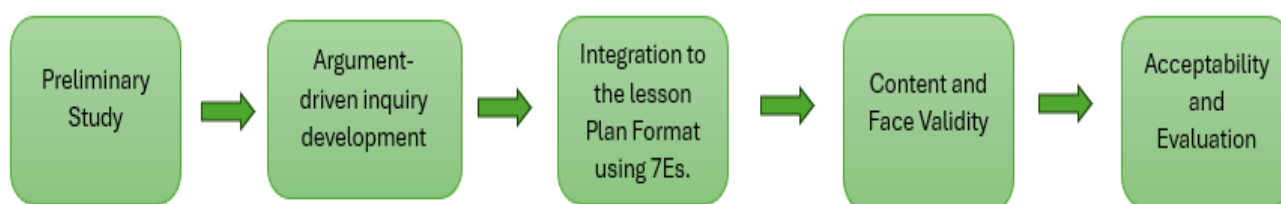


Figure 1. The research stage in the development of the lessons

The preliminary stage of the study began by reviewing the Grade 11 Chemistry competencies and drafting the

lesson components. The lessons are divided into seven major parts. This instructional framework covers the seven

phases of inquiry-based learning [35]. In the elicit phase, this is all about figuring out what the students already know [36]. The teacher begins by asking questions to determine the students' prior knowledge and any misconceptions they may have. This is accomplished through pre-assessment activities, such as quizzes or interactive exercises.

Understanding what students think allows the teacher to prepare better classes that challenge these ideas and generate fresh insights. The teacher captures the students' attention and stimulates their curiosity in the engage phase [37]. The teacher presents a thought-provoking scenario or a perplexing question about the topic. The goal is to capture students' curiosity and desire to learn more. This prepares students for more in-depth investigations and keeps them engaged. Then, students gain hands-on experience in the explore phase. Students perform experiments or engage in activities that enable them to collect data and make observations [38]. This hands-on experience allows children to develop their own ideas and explanations for the scientific data they are learning. They develop early arguments based on their observations, which allows them to think more thoroughly about the subject. After exploring, students gather to discuss the results of their investigations in the explain phase [39].

They present their preliminary arguments and discuss them with the other group members. During these argumentations, they assess the quality of each other's claims by examining the evidence and reasoning utilized. This collaborative discussion enables students to develop their ideas and gain a deeper understanding of diverse perspectives. Moreover, in the elaborate phase, the teacher facilitates a reflective discussion to reinforce the new concepts [40]. Students reflect on what they have learned and how it relates to their existing knowledge. This enables students to integrate the new knowledge into their existing understanding, making it more meaningful and easier to recall. Students then assess their understanding by creating and finalizing scientific arguments. Additionally, students take a post-assessment to determine how their comprehension has improved during the evaluation phase. This phase allows them to establish their knowledge and assess their own progress [41]. Further, students use what they learned in larger scenarios in the extend phase. They may apply their new knowledge to various circumstances or topics through reflective writing or projects [42]. This helps students realize the importance of their learning and encourages them to continue exploring and questioning beyond the classroom.


Physical Sciences  
Third Quarter  
School Year 2024-2025

Grade Level: Grade 11 Eloquent, Endurance, Enthusiastic, Efficient  
Date: December 9-17, 2024  
Teacher: Merogim P. Mugot  
School: Hinigdaan National High School

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**Collision Theory: Effects of Temperature, Concentration, Catalyst and Particle Size on Reaction Rate**

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 **Lesson Objectives:**

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After going through this module, you are expected to:

1. use simple collision theory to explain the effects of concentration, temperature, and particle size on the rate of reaction and
2. define catalyst and describe how it affects reaction rate; and

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 **Duration:**

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4 hours

Figure 2. The Preliminary Part of the Lesson

ELICIT



**Pre-Assessment**

1. Instruct students to go over the Pre-assessment segment in their learning material. This will allow students to assess and apply their existing knowledge of fundamental collision theory, specifically the effects of concentration, temperature, and particle size on the rate of reaction.
2. Inform students to keep track of their opinions as the course advances and encourage them not to change their responses as soon as the discussion begins.
3. Use the explanation sheet rubrics to evaluate students' understanding and/or prior knowledge of the content.

Analyze the questions and choose the letter of the correct answer.

1. What is the effect of catalyst in the reaction rate?
  - a. It decreases the rate of a chemical process.
  - b. It increases the rate of a chemical process without being consumed by it.
  - c. It is consumed during the reaction to speed it up.
  - d. It increases the reaction's activation energy.

Answer: \_\_\_\_\_  
Explanation: \_\_\_\_\_
2. Which of the following affects the reaction rate in the particle size or surface area as observed in the total time of reaction for uncrushed and crushed eggshells?
  - a. The uncrushed eggshells react faster because of the larger particle size.
  - b. The crushed eggshells react slower because of the smaller particle size.
  - c. The crushed eggshells react faster because of the larger surface area.
  - d. The uncrushed eggshells react slower because of the larger surface area.

4. Explanation Sheet Rubrics

Criteria	Excellent (4 pts)	Merit (3 pts)	Achieved (2 pts)	Needs Improvement (1 pt)	Score
Explanation of content	Each of the aspect of the content was discussed in a clear and simple way.	The key aspects of the content are discussed using the scientific terminology	Few contents are discussed vaguely.	It is unclear what the key aspects of content are.	
Accuracy of information	All information are accurate and well supported	Most Information are accurate and well supported	Information is accurate with some vague points	A good amount of the information is inaccurate and/or vague	
Spelling and grammar	All spelling and grammar are correct	Some spelling and grammar error	Some spelling and grammar error	Notable spelling and grammar error	
<b>TOTAL:</b>					
Highest possible score is 4 then it has 3 components. Hence, it gives us $(4 \times 3) / 3 = 4.0$					

Figure 3. The Second Part of the Lesson

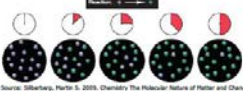
ENGAGE	EXPLORE									
<p><b>Identification of Guide Questions</b></p> <p>5. Introduce students with the concepts of chemical kinetics, with an emphasis on reaction rates and the factors that influence them, as well as connecting previous knowledge on the effect of temperature on molecular speed and collision frequency.</p> <p>Chemical kinetics is the study of reaction rates, the changes in concentrations of reactants (or products) as a function of time (Figure 2). Reactant concentrations decrease quickly in a reaction with a high rate and slowly in a reaction with a low rate.</p>  <p>Source: Silberberg, Martin S. 2009. Chemistry: The Molecular Nature of Matter and Change, 9<sup>th</sup> Edition.</p> <p>Figure 2. Reaction rates: the central focus of chemical kinetics. The rate at which reactant becomes product is the underlying theme of chemical kinetics. As the time elapses, reactant (purple) decreases and product (green) increases.</p> <p>Reactions occur at a wide range of rates (Figure 3). Some, like a neutralization, a precipitation, or an explosive redox process, seem to be over as soon as the reactants make contact—in a fraction of a second. Others, such as the reactions involved in cooking or rusting, take a moderate length of time, from minutes to months. Still others take much longer: the reactions that make up the human aging process continue for decades, and those involved in the formation of coal from dead plants</p>	<p><b>Conducting experiments or hand-on activity, Analyzing Data, and Developing a Tentative Argument</b></p> <p>7. After the activity, ask each group of students to create a tentative argument that includes a claim (a clear statement that answers the guiding question), evidence (data from the investigation that supports the claim), and reasoning (explaining why the data presented supports the claim and linking it to underlying scientific principles).</p> <p><b>Activity 1: Effect of Concentration on Reaction Rates</b></p> <p>Objective: Investigate the effect of concentration on the rate of a reaction.</p> <p>Materials: 2 similar cups 6 mL pure Vinegar 1.5 mL of Water 2 spoonful of Baking soda</p> <p>Procedure: 1. In one cup, use pure vinegar (3mL) and place one spoonful of baking soda. Record in Table 1 the time it takes for the reaction to happen. 2. In another cup, add pure vinegar (1.5mL) and water (1.5 mL) before you add the spoon full of baking soda. Record reaction time in Table 1</p> <table border="1"> <caption>Table 1 Effect of Concentration on Reaction Rates</caption> <thead> <tr> <th>Concentration</th> <th>Total Time of Reaction (mins)</th> <th>Observations</th> </tr> </thead> <tbody> <tr> <td>Pure Vinegar</td> <td></td> <td></td> </tr> <tr> <td>50% vinegar + 50% water</td> <td></td> <td></td> </tr> </tbody> </table> <p>Guide Questions</p>	Concentration	Total Time of Reaction (mins)	Observations	Pure Vinegar			50% vinegar + 50% water		
Concentration	Total Time of Reaction (mins)	Observations								
Pure Vinegar										
50% vinegar + 50% water										

Figure 4. Identification of Guide Questions &amp; Conducting Experiments

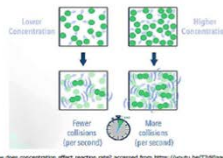
EXPLAIN	ELABORATE						
<p><b>Argumentation Session</b></p> <p>7. After exploring the activity, finalize your work and data. To answer the guide question from each activity, students must create a scientific argument consisting of the following:  <ul style="list-style-type: none"> <li>claim (a specific statement or conclusion that addresses the guiding question),</li> <li>evidence (data observed and collected during the exploration that supports your claim), and</li> <li>reasoning (explains the significance of the data presented to support your claim and connects related scientific principles to provide evidence to your claim).</li> </ul> </p> <p>8. To share their preliminary findings with others, we will use a round-robin system. This means that two members of the group will stay stationary at your room table (RT) station to discuss their group work while the remaining members will go around to the remaining RT stations to carefully perceive and analyze your classmates' initial results. Be prepared to present the group's initial scientific argument. The purpose of the argumentation session is not to persuade others that your argument is better; rather, it is to discover and correct errors or faulty reasoning in the arguments. The students will need to examine the content of the claim, the strength of each argument's reasoning as well as the quality of the evidence.</p> <table border="1"> <thead> <tr> <th colspan="2">Guiding Question:</th> </tr> </thead> <tbody> <tr> <td>Claim:</td> <td></td> </tr> <tr> <td>Evidence:</td> <td>Reasoning:</td> </tr> </tbody> </table>	Guiding Question:		Claim:		Evidence:	Reasoning:	<p><b>Reflective Discussion</b></p> <p>9. Discuss the factors that influence reaction rates based on theory and previous experiments. Ensure that the learners are the ones who draw conclusions from the experiments. Inquire about how the data may be explained using the collision theory.</p> <p>10. Effect of Concentration on Reaction Rates In Activity 1, pure vinegar has a more concentration than vinegar solution, which accelerates the reaction rate. Most reactions' rates are proportional to their reactant concentrations. Based on figure 3, reaction rates often increase as the concentration of one or more of the reactants increases. Increasing the concentration indicates there are more reactant particles in an area (volume), increasing the possibility of collisions. The increased frequency of collisions results to a faster reaction rate. To cause a chemical reaction, a specific number of energized molecules must be equal to or greater than the activation energy. As the concentration grows, so does the number of molecules with the least amount of energy required, increasing the reaction rate.</p> 
Guiding Question:							
Claim:							
Evidence:	Reasoning:						

Figure 5. Argumentation Session and Reflective Discussion

EVALUATE	EXTEND
<p><b>Argumentation Report</b></p> <p>14. After the activity, require students to write their final argumentation report that consists of a claim (a clear statement that answers the guiding question), evidence (data from the investigation that supports your claim), and reasoning (explains clearly why the data you presented supports your claim and consists of underlying scientific principles that link evidence to your claim). Below is the scoring rubrics to be used in checking students' written arguments.</p>	<p><b>Reflective Writing</b></p> <p>16. Encourage students to write a reflection. Students may consider the following questions below in writing their reflections.</p> <ul style="list-style-type: none"> <li>• What did I learn today? _____</li> <li>• What is the relation of the topic I learned to my daily living? _____</li> <li>• What concepts are still unclear to me? _____</li> </ul>

Figure 6. Argumentation Report and Reflective Writing

There are two major lessons developed for the third quarter of the grade 11 Chemistry, which covered the concepts of chemical structure and chemical reactions. The lessons were integrated with argument-driven inquiry activities. These activities were inserted in the acquisition part of the lesson plan, and instructions, scoring, and point system regarding the activities were provided. The figure above is a sample of the developed lesson, including its various parts. The researcher-made grade 11 Chemistry third-quarter lessons were presented to five instructional and curriculum experts and science teachers for corrections, face, and content validity. These experts have at least a

master's degree, taught in academe for at least five years, and have used inquiry-based learning in their classes.

Then, further revisions were done based on the comments and suggestions of the experts to improve the lesson content and format. As the final step of this process, the revised lessons were presented to thirty public school science teachers for evaluation of acceptability. These chosen science teachers and experts have taught in the academe for at least five years and are using inquiry-based activities in the class. They are also allowed to give their comments and suggestions after rating the lessons. Ethical standards were observed throughout the conduct of this

study. Below is the scoring procedure for the acceptability evaluation.

**Table 1. Scoring Procedure for the Acceptability of the Developed Lessons**

Mean Range	Descriptors	Interpretation
3.26-4.00	Very Satisfactory	Very High
2.51-3.25	Satisfactory	High
1.75-2.50	Poor	Low
1.00-1.75	Not Satisfactory	Very Low

### 3. Results and Discussion

**Table 2. Acceptability Rating of the Lessons in Terms of Content**

Factor 1: Content	Mean & SD	Interpretation
1. Content is suitable to the student's level of development.	3.80±0.41	Very High
2. Material contributes to the achievement of specific objectives of the subject area and grade/year level for which it is intended.	3.57±0.50	Very High
3. Material provides for the development of higher cognitive skills such as critical thinking, creativity, learning by doing, inquiry, problem-solving, etc.	3.77±0.43	Very High
4. Material is free of ideological, cultural, religious, racial, and gender biases and prejudices.	3.73±0.45	Very High
5. Material has the potential to arouse the interest of the target reader.	3.83±0.38	Very High
6. Adequate warning/cautionary notes are provided in topics and activities where safety and health are of concern.	3.93±0.25	Very High
<b>Over-all Mean and SD</b>	<b>3.77±0.40</b>	<b>Very High</b>

Content pertains to the appropriateness of the scope, range, and depth of topics in relation to the learning needs of the target audience and the attainment of specified learning outcomes. It also fosters the development of higher-order thinking skills. The content of the lessons, which is integrated with conceptual change and argument-driven inquiry, was assessed by thirty experts in curriculum and instruction, as well as science, for its acceptability. The results are summarized in Table 2. According to this table, each indicator achieved a mean score exceeding 3.26, while the overall mean for the content was 3.77, indicating a very high level.

This means that the lessons integrated with conceptual change argument-driven inquiry activities were acceptable and met the descriptors indicated in the Learning Resources Management and Development System (LRMDS) rating sheet of the Department of Education [34]. This very high rating may also be attributed to the relevance and applicability of the developed lessons in chemistry, which align with the Most Essential Learning Competencies (MELCs) of the Department of Education [43]. The experts noted in their evaluation that the lessons designed promote the development of valuable traits and values. These include a scientific attitude and reasoning, a desire for excellence, teamwork and cooperation, a willingness to learn new things, honesty and trustworthiness, the ability to discern right from wrong, respect, productive work, and both critical and creative thinking.

**Table 3. Acceptability Rating of the Lessons in Terms of Format**

Factor 1: Format	Mean & SD	Interpretation
<b>1. Prints</b>		
1.1 The size of letters is appropriate to the intended user.	3.90±0.31	Very High
1.2 Spaces between letters and words facilitate reading.	3.93±0.25	Very High
1.3 Font is easy to read.	3.47±0.68	Very High
1.4 Printing is of good quality (i.e., no broken letters, even density, correct alignment, properly placed screen registration).	3.40±0.56	Very High
<b>2. Illustrations</b>		
2.1 Simple and easily recognizable.	3.40±0.56	Very High
2.2 Clarify and supplement the text.	3.37±0.56	Very High
2.3 Properly labeled or captioned (if applicable).	3.40±0.56	Very High
2.4 Realistic / appropriate colors.	3.53±0.51	Very High
2.5 Attractive and appealing.	3.50±0.51	Very High
2.6 Culturally relevant.	3.47±0.57	Very High
<b>3. Design and Layout</b>		
3.1 Attractive and pleasing to look at.	3.50±0.51	Very High
3.2 Simple (i.e., does not distract the attention of the reader).	3.57±0.50	Very High
3.3 Adequate illustration in relation to text.	3.33±0.61	Very High
3.4 Harmonious blending of elements (e.g., illustrations and text).	3.67±0.48	Very High
<b>4. Paper and Binding</b>		
4.1 Paper used contributes to easy reading.	3.63±0.49	Very High
4.2 Durable binding to withstand frequent use.	3.57±0.50	Very High
<b>5. Size and Weight of Resource</b>		
5.1 Easy to handle.	3.47±0.63	Very High
5.2 Relatively light.	3.43±0.68	Very High
<b>Over-all Mean and SD</b>	<b>3.51±0.53</b>	<b>Very High</b>

The lesson format was evaluated based on factors such as prints, illustrations, design and layout, paper binding, as well as the weight and size of the resource. Additionally, it considered the quality of the paper, packaging, and binding, ensuring that these elements were suitable for the intended use and expected lifespan of the resource. According to the experts' ratings, each of the indicators has a mean score greater than 3.26, with the overall mean for the format being 3.51, which can be interpreted as very high. This suggests that the lessons, which incorporated conceptual change argument-driven inquiry activities, were well-received and met the criteria outlined in the Learning Resources Management and Development System (LRMDS) [34] rating sheet of the Department of Education in terms of their format. This very high rating may be attributed to the coherence between the topics and the activities, as well as the ease with which the lessons were prepared for educational use.

One of the most essential elements in developing educational materials is the effective presentation and organization of content. The presentation must be engaging, interesting, clear, and logical, facilitating a smooth progression of ideas that enhances learners' experiences and understanding. As indicated by the expert ratings in Table 4, each criterion received a mean score

exceeding 3.26, with an overall mean for presentation and organization at 3.43, which is indicative of a very high standard. This suggests that the lessons, which incorporate conceptual change argument-driven inquiry activities, are both acceptable and aligned with the criteria specified in the Learning Resources Management and Development System (LRMDS) rating sheet from the Department of Education [34]. The very high rating can also be attributed to the seamless flow of the lesson, which adheres to the 7Es model (Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend), allowing teachers to utilize the materials with ease.

**Table 4. Acceptability Rating of the Lessons in Terms of Presentation and Organization**

Factor 3: Presentation and Organization	Mean & SD	Interpretation
1. Presentation is engaging, interesting, and understandable.	3.60±0.56	Very High
2. There is a logical and smooth flow of ideas.	3.77±0.43	Very High
3. Vocabulary level is adapted to the target reader's likely experience and level of understanding.	3.43±0.57	Very High
4. The length of sentences is suited to the comprehension level of the target reader.	3.30±0.53	Very High
5. Sentences and paragraph structures are varied and interesting to the target reader.	3.40±0.56	Very High
Overall Mean and SD	3.43±0.53	Very High

**Table 5. Acceptability Rating of the Lessons in Terms of Accuracy and Up-to-datedness of Information**

Factor 3: Presentation and Organization	Mean & SD	Interpretation
1. Conceptual errors.	3.60±0.62	Very High
2. Factual errors.	3.87±0.35	Very High
3. Grammatical errors.	3.40±0.72	Very High
4. Computational errors.	3.33±0.84	Very High
5. Obsolete information.	3.40±0.62	Very High
6. Typographical and other minor errors (e.g., inappropriate or unclear illustrations, missing labels, wrong captions, etc.).	3.37±0.76	Very High
Over-all Mean and SD	3.49±0.65	Very High

The final factor in the evaluation sheet is the accuracy and currency of the information. This refers to the presentation of factual and up-to-date content, which helps prevent misconceptions or misunderstandings in the lessons. As shown in Table 5, each indicator has a mean score greater than 3.26, with an overall mean of 3.49 for accuracy and currency. This score can be interpreted as very high, indicating that the accuracy and currency of the information are deemed acceptable according to the Learning Resources Management and Development System (LRMDS) rating sheet from the Department of Education [34]. This very high rating could be due to the minimal or no conceptual, factual, grammatical, and computational errors in the developed lessons, which are integrated with conceptual change argument-driven inquiry activities. Moreover, this can also be attributed to the argumentation integrated into the lesson, which the experts believed consisted of problem-solving concepts, learning processes, and learning content, thereby enhancing the teaching, and learning outcomes. As

[11,12,13] have mentioned, argument-driven inquiry (ADI) methods have shown that they may increase students' scientific argumentation skills during learning and improve their critical thinking, reasoning, and conceptual understanding by integrating scientific argumentation. Also, this can enhance their understanding of scientific phenomena through asserting, arguing, and providing evidence to support their claims and arguments.

## 4. Conclusion

According to the assessments conducted by thirty experts in science and curriculum instruction, the developed grade 11 chemistry lessons, which integrate conceptual change and argument-driven inquiry activities, have been found to be acceptable. This suggests that these lessons can be effectively implemented in senior high schools, particularly in grade 11 chemistry classes. Moreover, the lessons are designed to cultivate essential 21st-century skills in students. Educators are encouraged to adopt the argument-driven learning method in their teaching, as it is recognized for being enjoyable, engaging, and centered on the learner. This instructional approach not only enhances students' comprehension of scientific concepts but also promotes critical thinking and problem-solving skills, which are essential in today's world.

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