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High School Students' Evolving Alternative Conceptions Related to the Volume of Gas

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Overview: This study investigated how students' implicit assumptions, formed during present learning, can lead to the construction of alternative conceptions of concepts to be learned in the future.

AUDIENCE: Instructional designers, Researchers, Science education leaders, Secondary science teachers, Chemistry educators

KEY POINTS

- The concepts addressed in the current curriculum include implicit information that is not directly stated or expressed but can be understood or inferred from the context.
- Although often excluded from lessons because it is not the current focus of interest, implicit information is intuitively interpreted by students.
- The implicit information that students intuitively interpret, namely implicit assumption, can be categorized into core assumptions, auxiliary assumptions, and context-inducing assumptions.
- These implicit assumptions can be combined with the scientific conceptions learned in the current learning context to form alternative conceptions for concepts which are dealt with in a future learning context.
- Researching alternative conceptions that originate from current learning but are relevant in future learning contexts can be helpful in learning progression research, as it can reveal the relationship between current and future curricula.

INTRODUCTION: In order to systematically develop learning progressions, it is necessary to investigate how the conceptions learned in the current curriculum are actually connected to the concepts dealt with in future curricula. This study aims to investigate how high school students' implicit assumptions, formed during the learning of mole-volume reasoning under individual gas conditions, lead to an alternative conception for a concept they will learn in the future (i.e., mole-volume reasoning under mixed gas conditions). For this study, we conducted interviews with seven high school students in South Korea and analyzed the data based on Lakatosian theory.

FINDINGS We found that students who had learned about mole-volume reasoning under individual gas conditions (i.e., Avogadro's principle) constructed three types of implicit assumptions when faced with a future learning context (i.e., in the context of mole-volume reasoning under mixed gas conditions). The first type is a core assumption concerning gas pressure, which appeared difficult to change when students faced the future learning context. The second type is auxiliary assumptions. These were formed to support the reasoning, or alternative conception, that was based on the scientific conception (i.e., Avogadro's principle) and the core assumption. These were comparatively less robust than the core assumption. The final type is a context-inducing assumption, which led students to hypothesize the future learning context on their own, even in the absence of direct provision of such context. The results of this study showed that these three types of implicit assumptions, combined with the scientific conception learned in the current curriculum, can unintentionally generate alternative conceptions for untaught concepts.

TAKEAWAYS Through a case study, we demonstrated how the learning outcomes in the current curriculum can be connected to the learning content in future curricula. Specifically, we showed how students' implicit assumptions, formed during their current learning experiences, can lead to the construction of alternative conceptions of concepts that will be learned in the future. This kind of investigation goes beyond simply knowing what students know and don't know. It identifies the relationships between students' reasoning across continuous educational contexts. In these regards, this kind of investigation can provide specific conceptual resources for future learning and, ultimately, be helpful in learning progression research.

Full Title: High School Students' Evolving Alternative Conception Related to the Volume of Gas: A Lakatosian Perspective