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Gases Concept Inventory (GCI): An Instrument Test To Analyze Students' Mental Models Of The Kinetic Theory Of Gases

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Is Gases Concept Inventory (GCI) reliable and valid to analyze students' mental models of the Kinetic Theory of Gases?

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Abstract

This poster is to promote a Gases Concept Inventory (GCI) as an instrument test to evaluate students' mental models on kinetic theory of gases. By evaluating mental models using GCI, teachers can assess students' initial perception and understanding in kinetic theory of gases, so they can prepare the best method to deliver kinetic theory of gases concept to students. THE GCI is analyzed by evaluating its validity, reliability, and difficulty level to prove that GCI is valid and reliable to be used.

Introduction

Background

Most students have frequently experienced misconceptions or misguided conceptions when they study some concepts, especially abstract concept that cannot be observed using human senses (Hestenes., et al, 1992; Kaltakci-Gurel D, 2017).

Identifying students' mental models is significantly important to analyze students' initial perception, understanding, and ability to imagine a particular concept. (Kurnaz & Eksi, 2015).

1

One difficult abstract topic taught in physics classes that is challenging for students is the kinetic theory of gases, the focus of this investigation.

Picture source: https://www.freepik.com

2

3

It is important to have an instrument to analyze students' mental models on kinetic theory of gases.

4

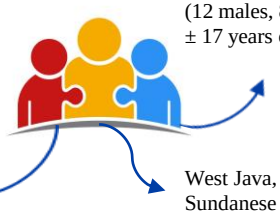
Hypothesis

The GCI instrument is reliable and valid to analyze students' mental model of kinetic theory of gases.

Methods

Participants

Coding based on gender and list number
Male > M
Female > F



20 respondents
(12 males, 8 females)
± 17 years old

West Java,
Sundanese Tribe

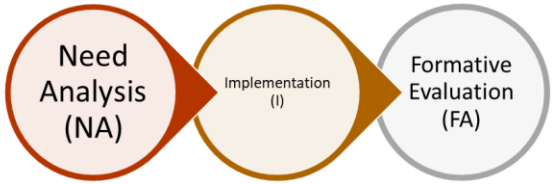
Picture source: https://www.vectorstock.com/royalty-free-vector/three-people-puzzle-teamwork-logo-vector-19368295

Design

The GCI is developed using FODEM (Formative Development Methods) model (Suhonen, J., et al, 2012).

Analyzing physics concepts, deciding the format and developing the instrument.

Evaluating students' responses using Rasch Model



Disseminating the instrument to the participants **using online platforms**

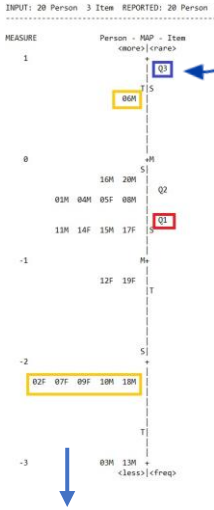
Test Instrument

The GCI consists of 3 questions which have four-tiers in each question. The format of GCI is as follow:

Tier-1 (Main Question in Partciular Concept)	Tier-3 (Reason related to answer in tier-1)
Tier-2 (Level of confidence for Tier-1)	Tier-4 (Level of confidence for Tier-3)

Findings

Difficulty Level



Validity

Cub Concepts	Question number	Outfit		Interpretation (Item validity)
		MNSQ	ZSTD	
Boyle's Law	1	.79	-.46	Valid
Gay-Lussac's Law	2	.92	-.06	Valid
Charles's Law	3	1.35	.80	Valid

Reliability

Person reliability	Interpretation	Item reliability	Interpretation
.63	Good	.81	Very good
Cronbach Alpha	**Interpretation**	**Decision**	
.83	Very good	**Reliable**	

- The Q3 is the most difficult question, while Q1 is the easiest question.
- A good instrument is instrument which has proportional difficulty level.

Conclusion

It can be concluded that Gases Concept Inventory (GCI) is valid and reliable to be used to analyze students' mental model of Kinetic Theory of Gases. This will help teachers to assess students' initial perception and understanding, so they will prevent students' misunderstanding by delivering the concept using preferrable method.

References

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2. Kaltakci-Gurel, D., Eryilmaz, A., & McDermott, L. C. (2017). Development and application of a four-tier test to assess pre-service physics teachers' misconceptions about geometrical optics. Research in Science and Technological Education. https://doi.org/10.1080/02635143.2017.1310094
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