TEKNIK PEMBUATAN INSTRUMEN PENELITIAN BERBASIS STEM

(Technique to Develop an Instrument of STEM based Research)

Disampaikan pada Kuliah Umum Prodi Pendidikan Kimia
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Chemistry through education (CTE)

Education through chemistry (ETC)

Pendidikan Kimia 4.0

- Concept essential selection
- Real life chemistry
- Chemistry case of industry
- 4 C skills
- ICT integration

Penguatan Pembelajaran kimia di era 4.0

Research Instruments

Research Objective

Components: Teacher, student, learning tools and process

STEM Research??

Main Goals

STEM Education
(science, technology, engineering and mathematics)

- learning STEM content and practices
- developing positive dispositions toward STEM
- preparing students to be lifelong learners

1. learning STEM content and practices

- ❑ STEM framework and knowledge
- ❑ STEM Importance
- ❑ STEM Integration in learning tools
- ❑ Effectiveness of STEM based learning

What kind of instrument is needed?

2. Developing positive dispositions toward STEM

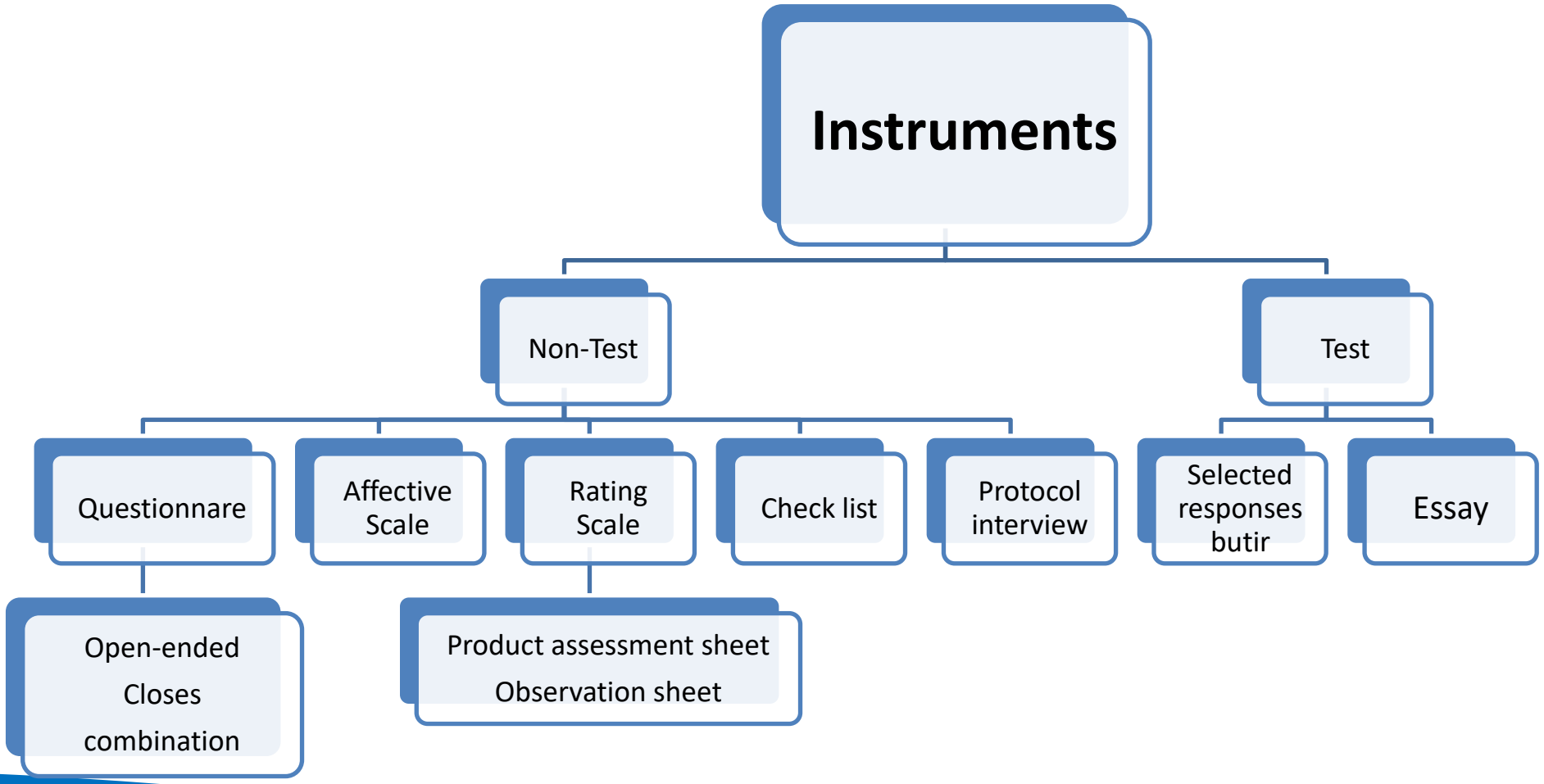
- ❑ Perception
- ❑ Scientific attitude
- ❑ Motivation
- ❑ Self-efficacy
- ❑ Self-regulated
- ❑ Self-esteem
- ❑ Learning anxiety

What kind of instrument is needed?

3. preparing students to be lifelong learners

- ❑ Analytical thinking
- ❑ Critical thinking
- ❑ Creative thinking
- ❑ Creativity
- ❑ Collaboration skills
- ❑ Communication skills
- ❑ Problem solving skills
- ❑ Decision making skills
- ❑ Argumentation skills
- ❑ Literacy ability

What kind of instrument is needed?


Instruments
Non-Test
Test
Questionnare
Affective Scale
Rating Scale
Check list
Protocol interview
Selected responses butir
Essay
Open-ended
Closes combination
Product assessment sheet
Observation sheet

Protocol Interview

➔ **Obtain participants responses by orally**
Questions list

Questionnare

➔ **To obtain participants responses (attitude/opinion) in writing factually**

➔ **Statement & Altenative respons option (3, 4,5,7,,10)**

SCALE

- ❑ almost the same as the questionnaire where there are statements and alternative response options
- ❑ Data in the form of psychological concepts that describe aspects of personality
- ❑ Statement indicate to behavior indicators
- ❑ response is scored through scaling.
- ❑ Alternative scaling : 3, 4, 5,7, 10
- ❑ Need psychometric measurement

Rating Scale

- consists of a number / set of characteristics or qualities to make decisions
- used for direct observation of specific aspects of a behavior / performance
- arrange the rubric for scoring guideline

Check List

- just justify yes or no
- as a guide for checking the appearance of expected activities / behavior

how are to obtain research instruments?

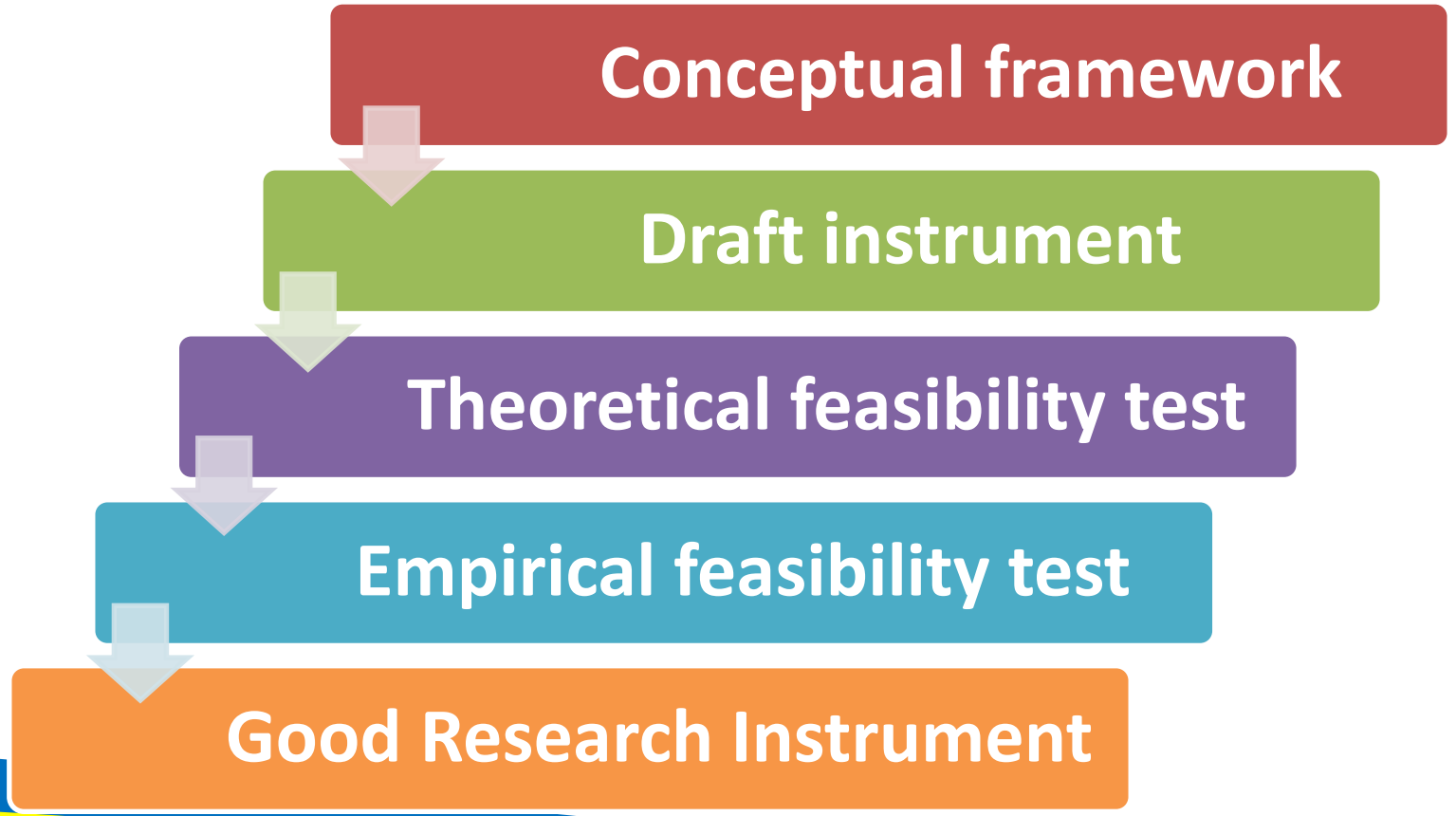
1. Using/Adopting standarized instrument (Mental Measurement Yearbook, ERIC search, previous research (exactly similar)

2. Adapting/modyfing of instrument from previous research

3. Developing or constructing an instrument

how are to develop/construct research instruments?

STEPS TO DEVELOP RESEARCH INSTRUMENT



For example to develop self-efficacy scale

Variable	Conceptual definition	Aspect of Self-efficacy	Selected Aspects and variables
Self-efficacy on STEM implementation	Bandura (1977) People's beliefs about their capabilities to produce effects or certain achievements Bandura (1994) Self-efficacy beliefs determine how people feel, think, motivate themselves and behave	Belief Motivation Self-regulated	1. Belief . Belief about self-performance in STEM learning . Belief about understanding STEM concept 2. Self-regulated … .. etc (related to STEM framework)
	Woolfook (1990) Personal characteristics that demonstrate beliefs of their ability	Belief Effort	
	Etc		

For example to develop rubrics of STEM product

DEFINE VARIABLE

- Quality of STEM Product

CONCEPTUAL DEFINITION OF QUALITY

DEFINE ASPECTS OF QUALITY

- Depend on kind of product
- Based on appropriate sources

DESCRIBE ASPECTS INTO INDICATORS OF QUALITY

DEFINE OF RANGE OF SCORES AND DESCRIBE THE CRITERIA EACH OF SCORE

Theoretical feasibility test

➔ By expert judgement (content, logic and face validity)

➔By user thinking (face validity and usability)

➔The analysis in this process is emphasized in qualitative approach

➔It is better if also use quantitative approach (Aikens index, CVR etc)

Empirical feasibility test

➔By testing out of research samples (construct validity and reliability)

➔For test, scale

➔By implementation with several observers (inter-rater reliability)

➔For rating scale/rubrics

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Development of analytical thinking ability and attitudes towards science learning of grade-11 students through science technology engineering and mathematics (STEM education) in the study of stoichiometry

Patcharee Chonkaew,[a] Boonnak Sukhummek*[a] and Chatree Faikhamta[b]

The purpose of this study was to investigate the analytical thinking abilities and attitudes towards science learning of grade-11 students through science, technology, engineering, and mathematics (STEM) education integrated with a problem-based learning in the study of stoichiometry. The research tools consisted of a pre- and post-analytical thinking ability test, a science learning attitude test, classroom observations, student reflective journals, and semi-structured interviews. The findings indicated that STEM learning activities based on problem-based learning successfully developed analytical thinking abilities and attitudes towards science learning. Consequently, the students realized how important theories are, and were able to integrate their knowledge from various fields to solve problems and to create new innovations. About 80% of the students showed higher analytical thinking ability scores above the prescribed criterion of 70% of the full score. After learning, the scores of the students were higher than those before learning at a confidence level of 0.01. The attitudes towards science learning were higher than those before learning at a confidence level of 0.01. The successful activities of STEM started with offering knowledge to students through an inquiry-based process until they could construct the knowledge on their own. After that, the teacher initiated a problem situation and allowed each group of students to create a useful product adopted from the experimental results *via* integrating STEM knowledge to modify their creative works.

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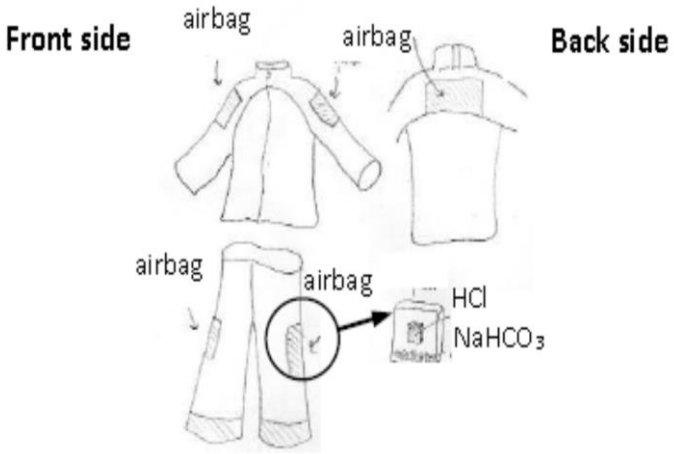
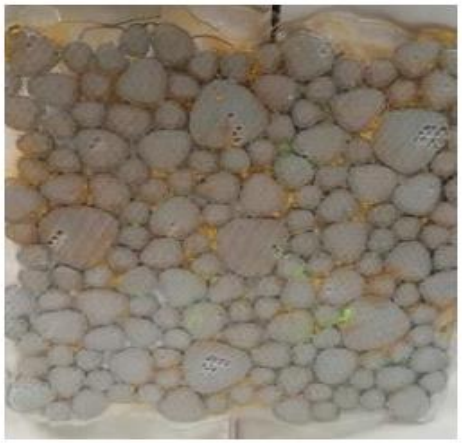


Science (S)	The mass of substances in the chemical reaction and the relationship of quantities of substances in the chemical equation
Technology (T)	Inventing mechanical parts of the life suit to make it practically and easily portable
Engineering (E)	Selecting substances to make a life suit and designing its shape
Mathematics (M)	Calculating a volume of gas produced, proper quantities of substances used for the reaction, and calculating the volume of the life suit to ensure that it had the right proportion with the gas produced

Integrating STEM to create a life suit



Sparkling tile

Hourglass

Whirling jar

Various shooting tool designs from the reaction of O_2 and H_2 gases and the real model of the automatic fishing tool.

Examples of work pieces and tools designed by students

Figure 1

Figure 2

Figure 3

Figure 4

THANK YOU

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