Assessing Validity of Cognitive Load Scale in a Problem-Based Learning Setting

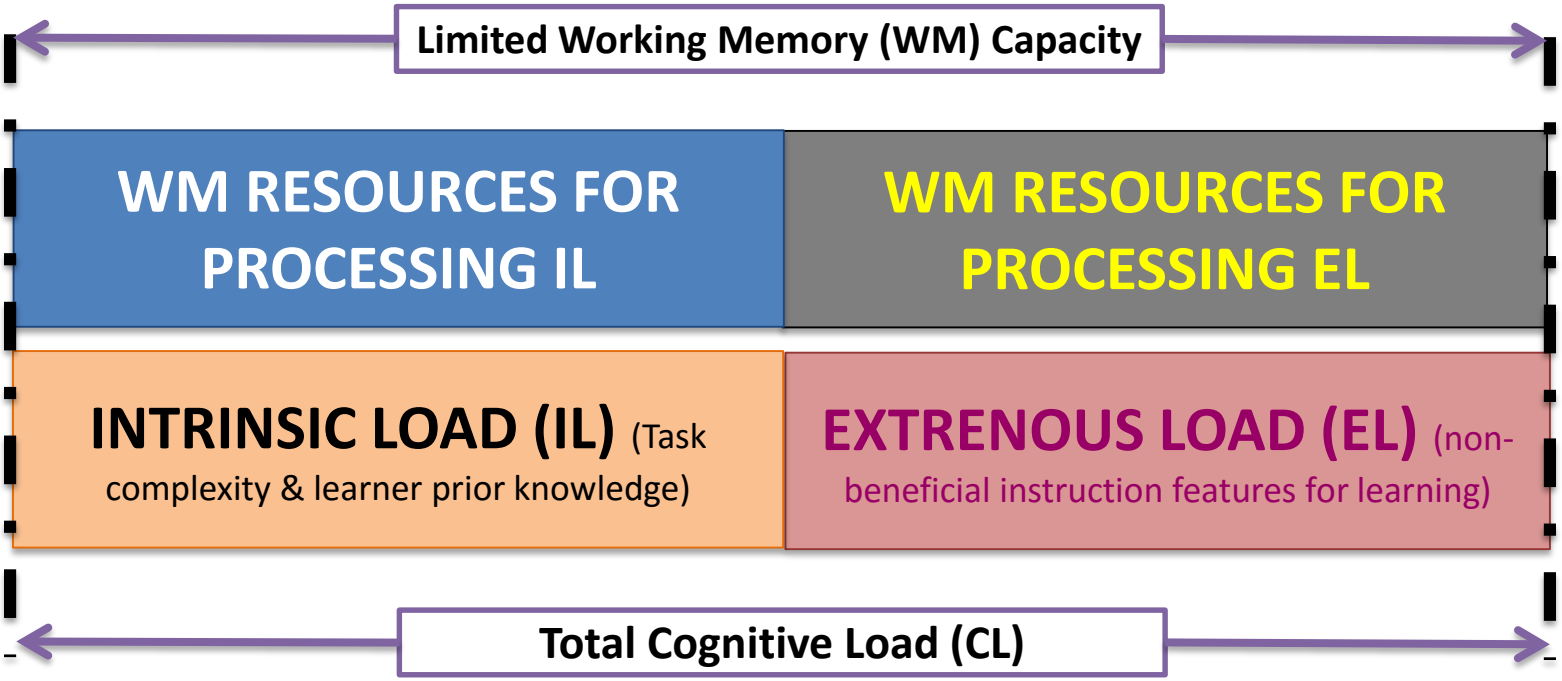
Muhamad Saiful Bahri Yusoff[1], Siti Nurma Hanim Hadie[2]

[1]Department of Medical Education, [2]Department of Anatomy, School of Medical Sciences, Universiti Sains Malaysia, Kota Bharu, Kelantan, Malaysia.

Email: msaiful_bahri@usm.my

COGNITIVE LOAD THEORY

Total cognitive load should not exceed the limited **capacity of the working memory**



Total cognitive load is contributed by **summation of intrinsic and extraneous load**

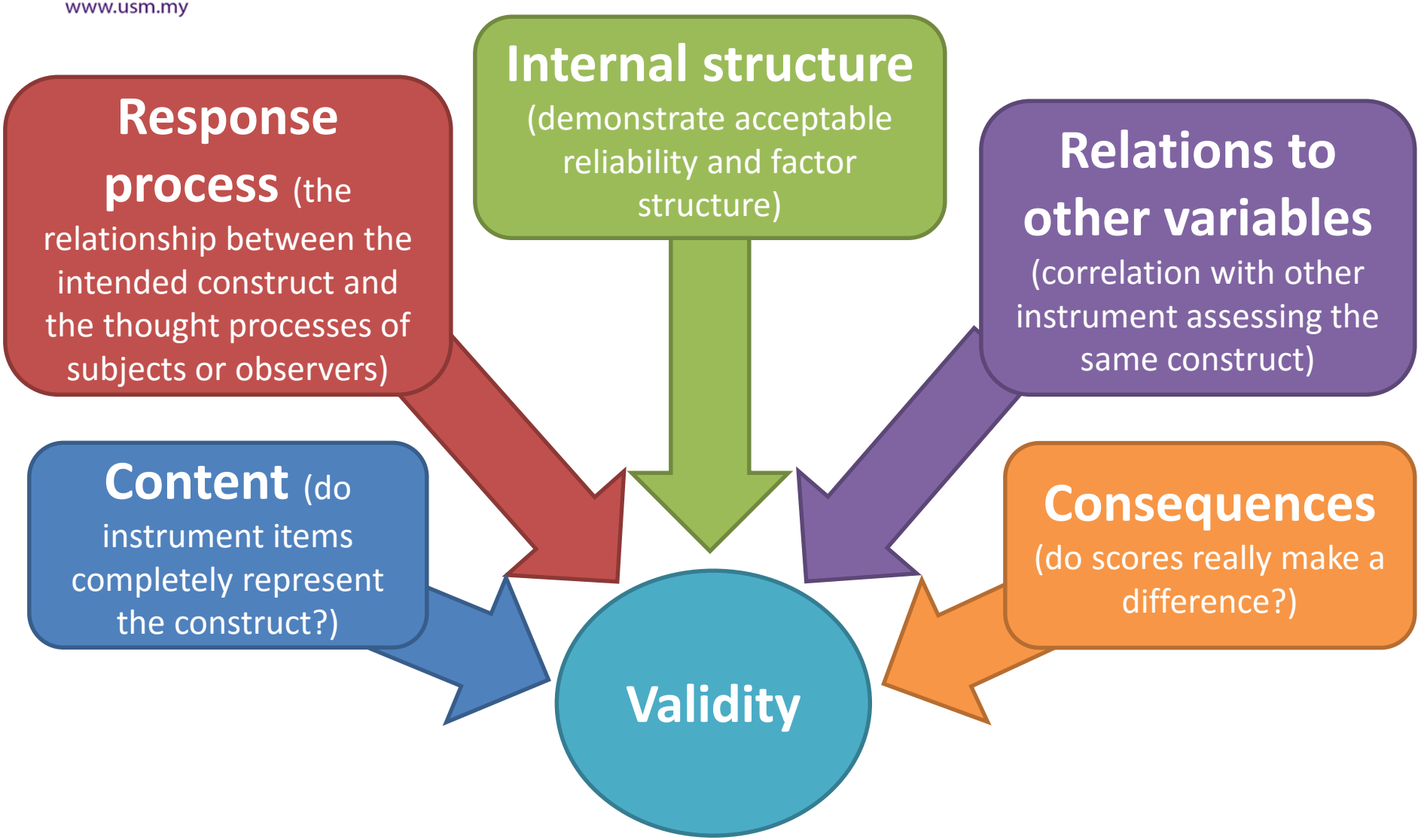
(Bannert et al., 2009; de Croock et al., 1998; Grobe & Renkl, 2006; Kalyuga, 2011; Leppink et al., 2014; Sweller, 1988; Van Gog et al, 2004; Van Gog et al., 2006; Van Gog et al., 2009; van Merrienboer et al., 2002)

COGNITIVE LOAD MEASUREMENT

- **Subjective**
  - Learner self-rating of mental effort (during the task)
  - Learner self-rating of difficulty (after the task)
  - **Cognitive Load Scale (CLS)** (measures IL, EL & Self-Perceived Learning)
- **Objective**
  - Task performance
  - Input variables, such as task difficulty
  - Process-related behavioural variables, such as psychophysiological measures

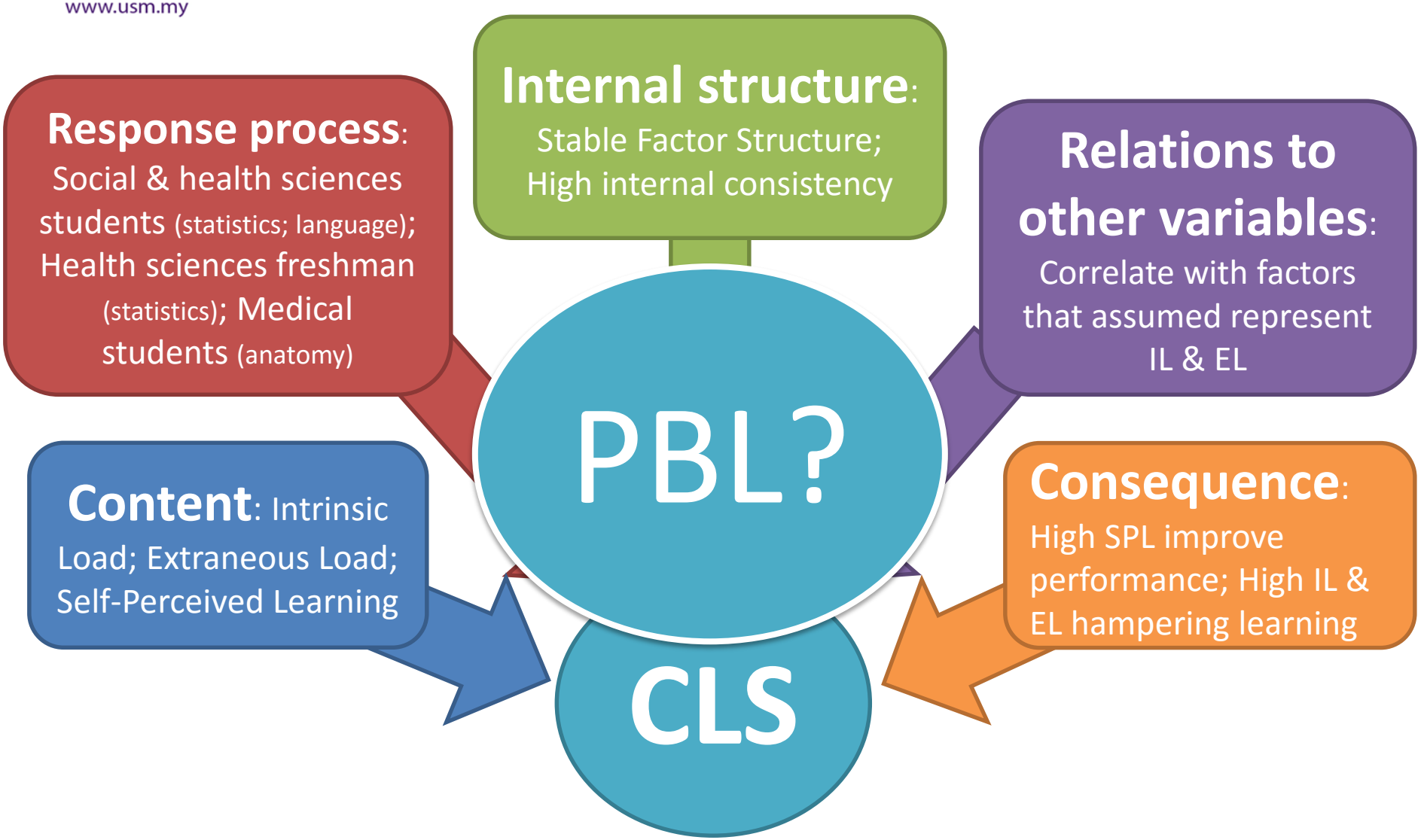
(Galy et al., 2012; Leppink et al., 2013,2014; Plass et al., 2010; Pass, 1992; Young et al., 2014)

VALIDITY EVIDENCE



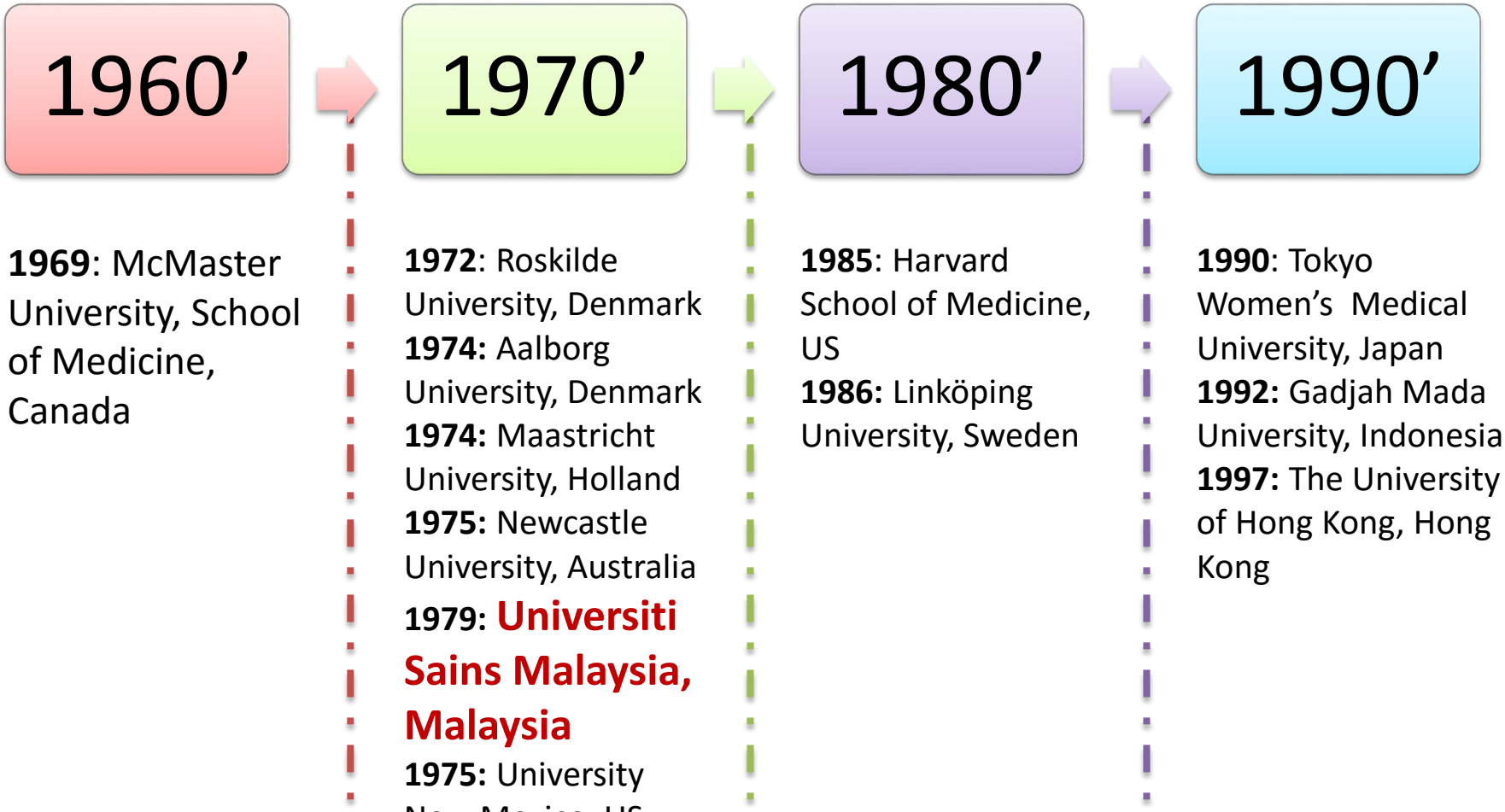
(Cook & Beckman, 2006. Current Concepts in Validity and Reliability for Psychometric Instruments: Theory and Application. *American Journal of Medicine*)

VALIDITY EVIDENCE OF CLS



(Bergman et al., 2015; Leppink et al., 2013,2014)

PBL: HISTORICAL OVERVIEW



(Virginie Servant, 28 May 2014, The Origins of PBL, Erasmus University College. http://www.youtube.com/watch?v=iNldRmR1Aj8)

PBL: PROCESS

Step 1	• Clarify unfamiliar terms
Step 2	• Define problems to be discussed
Step 3	• Brainstorm on the problems
Step 4	• Elaboration of the proposed explanations
Step 5	• Formulation of learning objectives
Step 6	• Self-study to gather information in relation to the learning objectives
Step 7	• Share the results of self-study with the group members
Step 8	• Consolidation on the key learning objectives by experts

PBL: TRIGGER

Respiratory System Course (GMT 105)

PBL 8:
'Crackling Chest'

PHASE I
YEAR 1
2015/2016

Mr. David, a 45-year-old odd-job worker was admitted to hospital with a five-day history of high-grade fever, productive cough with yellowish sputum. He also complained of left-sided chest pain during inspiration and cough. He was initially very reluctant to be admitted.

On physical examination, the patient was alert but dyspnoeic. There was no cyanosis or clubbing. His temperature was 40°C, pulse rate was 120 beat /minute, respiratory rate was 36 breath/minute and blood pressure was 120/80 mmHg.

Examination of respiratory system revealed reduced chest expansion on the left side with in-drawing of lower left intercostal spaces during inspiration. Percussion note was dull over the left lower zone. Bronchial breath sounds and coarse crackles were also heard over the same area.

Examination of other systems was unremarkable.

The following are the results of investigations done for this patient.

1.	Haemoglobin	:	12.0 g /dL
2.	Total leukocyte count	:	20.2 x 10^9/L
	Differential count:		
	Neutrophils	:	88%
	Lymphocytes	:	11%
	Eosinophils	:	1%
3.	Sputum Gram stain	:	Numerous polymorphs seen.
		:	Epithelial cells: 1 – 2 per low power field.
		:	Gram positive cocci seen.
4.	Sputum culture and sensitivity	:	Pending.
5.	Chest radiograph	:	Consolidation of the left lower zone

The attending doctor prescribed empiric intravenous antibiotic. The patient's temperature began to settle after 2 days. The sputum culture later grew pure growth of *Streptococcus pneumoniae*. After one week, his condition improved clinically.

Learning Outcome

At the end of the session, students should be able to:

LO1	Explain the clinical presentation of this case scenario in relation to the pathophysiology of respiratory tract infection
LO 2	Interpret the investigations for respiratory tract infection
LO3	Discuss the psychosocial implication of respiratory tract infection in this case

"A **TRIGGER** is **problems** that **provide** the **key units for structuring relevant learning**."

(Davis & Harden, 1999)

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"The **nature of student learning in PBL** is to a large extend **depend on quality of TRIGGERS** presented to them."

(Gijselaers & Schmit, 1990; Schmit et al., 1995)

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PBL: PARTICIPANTS' ROLES

Tutor

- Encourage all group members to participate
- Assists chair with group dynamic and keeping to time
- Check scribe keeps an accurate record
- Prevent side tracking
- Ensure group achieve appropriate learning objectives
- Check understanding
- Assess performance

Chair

- Lead the group through the process
- Encourage all members to participate
- Maintain group dynamics
- Keep to time
- Ensures group keep to tasks in hand
- Ensures the scriber can keep up and is making accurate record

Scribe

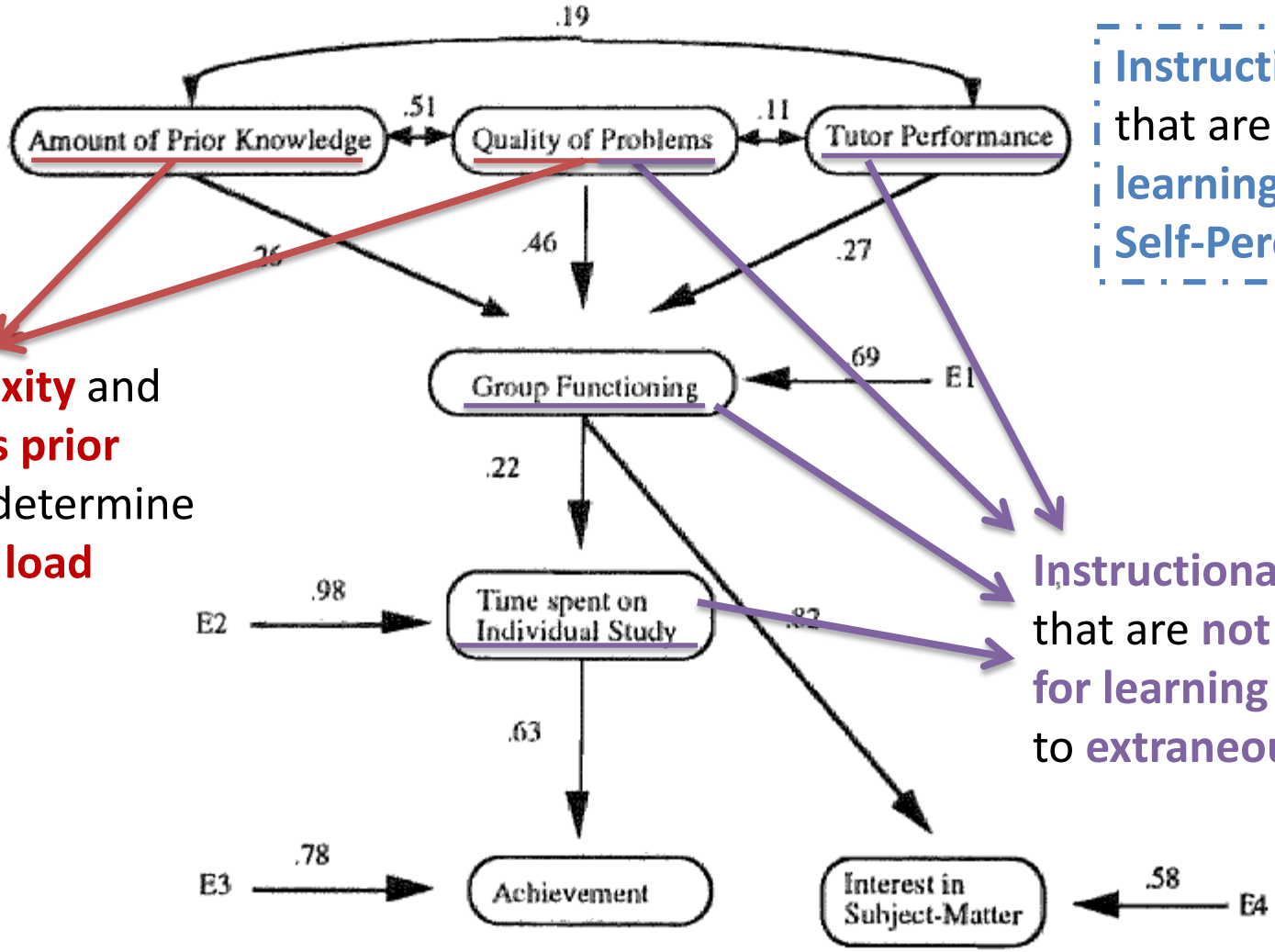
- Records points made by group
- Help group order their thoughts
- Participate in discussion
- Record resources used by group

Group Member

- Follows the steps of process in sequence
- Participate in discussion
- Listens to and respects contributions from others
- Ask open questions
- Research all learning objectives
- Shares information with others

(Wood, 2003)

PBL INSTRUCTIONAL VARIABLES & CL

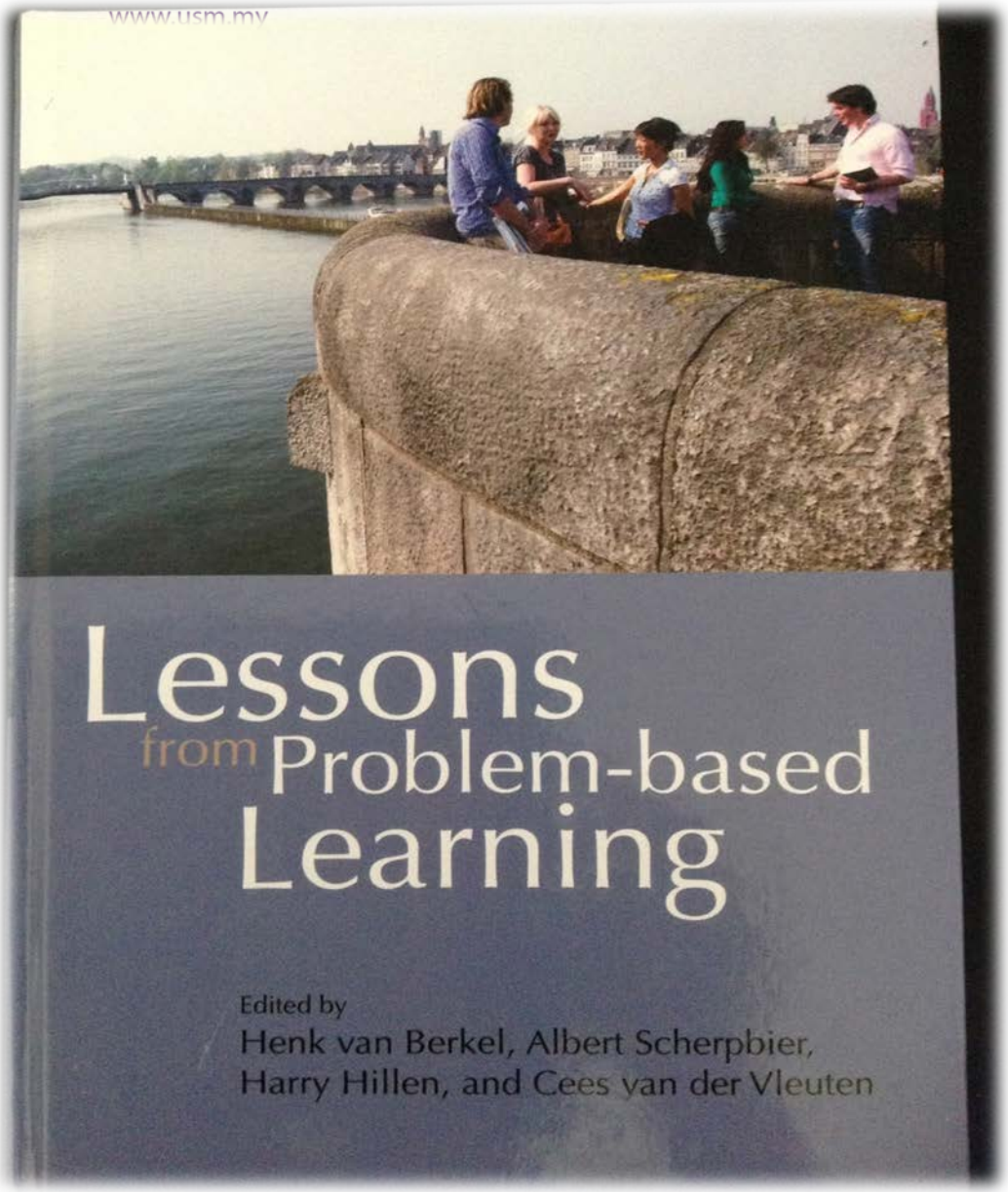


Instructional features that are **beneficial for learning** contribute to **Self-Perceived Learning**

Task complexity and the **learner's prior knowledge** determine the **intrinsic load**

Instructional features that are **not beneficial for learning** contribute to **extraneous load**

(Gijselaers & Schmit, 1990; Schmit et al., 1995)



Maastricht Experience on PBL

Table 24.1 Comparison between the performance of students and graduates of the Maastricht problem-based medical curriculum and conventional medical schools on various outcome measures

First author and publication year	Comparison groups	Statistically significant differences
Medical knowledge		
Answering questions about knowledge		
Verwijnen et al. (1990)	Volunteers from schools A and B, May 1979–September 1980	B better than Maastricht and A
	Volunteers from schools A and B, September–November 1981	B better than Maastricht and A
	Volunteers from schools A and B, non-select sample from C, March–September 1983	No difference
	Random sample from school C, March 1983	No difference
Verhoeven et al. (1998)	Volunteers from the Nijmegen school, December 1994	No difference
	Volunteers from the Nijmegen school, March 1995	No difference
Van der Vleuten et al. (2004)	Populations from the Groningen and Nijmegen school; first 4 years of the Leiden school	Maastricht and Groningen better than Nijmegen and Leiden
Imbos et al. (1984)	Random sample from a non-disclosed medical school	Maastricht better
Prince et al. (2003)	Sample from all 7 other schools	No difference
Self-assessment		
Schmidt et al. (2006)	Volunteer graduates from Rotterdam	Rotterdam better than Maastricht
Diagnostic reasoning skills		
Diagnosing cases		
Schmidt et al. (1996)	Volunteers from Groningen and Amsterdam	Maastricht and Amsterdam better than Groningen
Schuwirth et al. (1999)	Volunteers from Groningen	Maastricht better than Groningen
Processing and recalling cases		
Boshuizen et al. (1994)	Small samples of volunteers from Amsterdam	Maastricht better than Amsterdam
Boshuizen & Claessen (1982)	Small samples of volunteers from Utrecht	Maastricht better than Utrecht on one task; no differences on the other
Interpersonal skills		
Assessment by observers		
Van Dalen et al. (2002)	Volunteers from Leiden	Maastricht better than Leiden
Self-assessment		
Prince et al. (2005)	Volunteer graduates from four unspecified medical schools	Maastricht better than the other 4 schools

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Remmen et al. (1999)	Volunteers from Ghent and Antwerp	Maastricht better than Ghent and Antwerp
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Perception of the quality of the curriculum		
Steenkamp et al. (2004, 2006, 2008)	Samples from all medical schools	Maastricht better than all
Retention rates		
Post et al. (1986)	Graduates from all medical schools, entering 1970	Maastricht better than all
Schmidt et al. (2009a)	Graduates from all medical schools, entering between 1989 and 1998	Maastricht better than all

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Medical knowledge:
Inconsistent results between PBL vs. non-PBL

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Diagnostic reasoning skills: Consistently PBL based is better than non PBL based

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Physical examination:
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Medical knowledge		
Answering questions about knowledge		
Verwijnen et al. (1990)	Volunteers from schools A and B, May 1979–September 1980	B better than Maastricht and A
	Volunteers from schools A and B, September–November 1981	B better than Maastricht and A
	Volunteers from schools A and B, non-select sample from C, March–September 1983	No difference
	Random sample from school C, March 1983	No difference
Verhoeven et al. (1998)	Volunteers from the Nijmegen school, December 1994	No difference
Van der Vleuten (2004)		gen better iden
Imbos et al. (19		
Prince et al. (20		
Self-assessment		
Schmidt et al. (2006)	Volunteer graduates from Rotterdam	Rotterdam better than Maastricht
Diagnostic reaso		
Diagnosing case		
Schmidt et al. (1		rdam etter
Schuwirth et al.		Groningen
Processing and r		
Boshuizen et al.		Amsterdam
Boshuizen & Claessen (1982)	Small samples of volunteers from Utrecht	Maastricht better than Utrecht on one task; no differences on the other
Interpersonal skills		
Assessment by observers		
Van Dalen et al. (2002)	Volunteers from Leiden	Maastricht better than Leiden
Self-assessment		
Prince et al. (2005)	Volunteer graduates from four unspecified medical schools	Maastricht better than the other 4 schools

(Continued)

General academic skills: PBL based is better than non PBL based

Perception of the quality of the curriculum: PBL based is perceive more positive than non PBL based

Table 24.1 (*continued*) Comparison between the performance of students and graduates of the Maastricht problem-based medical curriculum and conventional medical schools on various outcome measures

First author and publication year	Comparison groups	Statistically significant differences
Schmidt et al. (2006)	Volunteer graduates from Rotterdam	Maastricht better than Rotterdam
Practical medical skills		
Physical examination assessed by observers		
Scherpbier (1997)	Volunteers from Groningen	Maastricht better than Groningen
Answering questions about physical examination		
Remmen et al. (1999)	Volunteers from Ghent and Antwerp	Maastricht better than Ghent and Antwerp
Remmen et al. (2001)	Volunteers from Ghent, Antwerp and Groningen	Maastricht better than Groningen, both better than Ghent and Antwerp
Self-assessment		
Schmidt et al. (2006)	Volunteer graduates from Rotterdam	Maastricht better than Rotterdam
Cognitive skills (problem-solving, seeking information)		
Self-assessment		
Schmidt et al. (2006)	Volunteer graduates from Rotterdam	Maastricht better than Rotterdam
General academic skills (conducting research, writing, presenting papers)		
Self-assessment		
Schmidt et al. (2006)	Volunteer graduates from Rotterdam	No difference
Perception of the quality of the curriculum		
Steenkamp et al. (2004, 2006, 2008)	Samples from all medical schools	Maastricht better than all
Retention rates		
Post et al. (1986)	Graduates from all medical schools, entering 1970	Maastricht better than all
Schmidt et al. (2009a)	Graduates from all medical schools, entering between 1989 and 1998	Maastricht better than all

* The schools compared were anonymized in this study.

Henk van Berkel, Albert Scherpbier, Harry Hillen, Cees van Der Vleuten. (2010). Lessons from Problem-Based Learning. New York, Oxford University Press, pg 229-230

ANTICIPATED CL IN PBL

IL — **Task complexity** and the **learner's prior knowledge** → **Moderate to High**

EL — **Instructional features** that are **not beneficial for learning** → **Low to Moderate**

SPL — **Instructional features** that are **beneficial for learning** → **Moderate to High**

RESEARCH QUESTIONS

3 Questions

- To what extent does **CLS distinguishably measure IL, EL & SPL** in PBL setting?
- Does **CLS** is **a reliable measurement** tool of cognitive loads in PBL setting?
- To what extent does **CLS** score **reflect the anticipated cognitive loads in PBL**?

MATERIALS & METHODS

Study Design

- A cross sectional for a validation study.

Sample Size

- Calculated sample size: **50 to 100 sample is adequate** (10 item self-rating; 5-10 samples per item)
  (Costello & Osborne, 2005).

Sampling

- Purposive sampling method.

MATERIALS & METHODS

Participants

- 125 first year medical students in 2015/2016 academic session.
- SPICES (student-centred, problem-based, integrated, community-based, elective, systematic and spiral) medical curriculum.
- 15 PBL groups (8-9 students per group).
- 25 PBL sessions.
- Per PBL, 2 meetings, 2 hours per meeting, usually scheduled at the beginning and end of each week.

MATERIALS & METHODS

Data Collection

- CLS was administered the medical students immediately after the first PBL meeting.
- CLS was immediately collected after the first PBL meeting.
- Participation was voluntary.
- A short briefing (less than 5 min) on the CLS was provided to the participants and completion of CLS was expected to take less than 5 min.

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MATERIALS & METHODS

COGNITIVE LOAD SCALE

Dear student,

This inventory measures your cognitive load during the Problem-based learning (PBL) session. All of the following 10 questions refer to the PBL session that has just finished. Please take your time to read each of the questions carefully and please tick (√) your response on the column based on the following rating scale:

Not all the case — Completely the case

0 1 2 3 4 5 6 7 8 9 10

A ten-point semantic rating scale

Figure 1: The Cognitive Load Scale

Measures participant's subjective ratings

NO.	ITEMS	RATING SCALE										
		0	1	2	3	4	5	6	7	8	9	10
1.	The topics covered in the PBL were very complex.											
2.	The PBL covered terminologies that I perceived as very complex.											
3.	The PBL covered concepts and definitions that I perceived as very complex.											
4.	The instructions and explanations during the PBL were very unclear.											
5.	The instructions and explanations during the PBL were full of unclear language.											
6.	The instructions and explanations during the PBL were, in terms of learning, very ineffective.											
7.	The PBL really enhanced my understanding of the topics covered.											
8.	The PBL really enhanced my understanding of the terminologies covered.											
9.	The PBL really enhanced my knowledge of concepts and definitions.											
10.	The PBL really enhanced my knowledge and understanding of the subject.											

Intrinsic load (1–3)

Extraneous load (4–6)

Self-perceived learning (7–10)

Interpretation of the mean score of each:

Low level = 0-4

Moderate level = more than 4 and less than 7

High level = 7 and more

(Modified from Leppink et al., 2013,2014)

MATERIALS & METHODS

Data Analysis

- **CFA** was performed by **AMOS** 22 to examine its **internal structure**:
  - **Construct validity**: Goodness of Fit Indices (Table 1)

Table 1: Goodness of fit indices that were used to signify model fit.

Name of category	Name of index	Level of acceptance
Absolute fit[1]	Root Mean Square of Error Approximation (RMSEA)	less than 0.08 (Browne & Cudeck, 1992)
	Goodness of Fit Index (GFI)	more than 0.9 (Jöreskog & Sörbom, 1984)
Incremental Fit[2]	Comparative Fit Index (CFI)	more than 0.9 (Bentler, 1990)
	Tucker-Lewis Index (TLI)	more than 0.9 (Bentler & Bonett, 1980)
	Normed Fit Index (NFI)	more than 0.9 (Bollen, 1989)
Parsimonious fit[3]	Chi Square/Degree of Freedom (Chisq/df)	less than 5 (Marsh & Hocevar, 1985)

[1]Absolute Fit: Measures overall goodness-of-fit for both the structural and measurement models collectively. This type of measure does not make any comparison to a specified null model (incremental fit measure) or adjust for the number of parameters in the estimated model (parsimonious fit measure). [2]Incremental Fit: Measures goodness-of-fit that compares the current model to a specified "null" (independence) model to determine the degree of improvement over the null model. [3]Parsimonious Fit: Measures goodness-of-fit representing the degree of model fit per estimated coefficient. This measure attempts to correct for any "overfitting" of the model and evaluates the parsimony of the model compared to the goodness-of-fit.

MATERIALS & METHODS

Data Analysis

- **CFA** was performed by **AMOS** 22 to examine its **internal structure**:
  - **Construct validity**: Goodness of Fit Indices (Table 1)
  - **Convergent validity**: 1) Factor loading (more than 0.5); 2) Average variance extracted (AVE; more than 0.5); 3) Composite reliability (CR; more than 0.6) (Hair et al., 2009; Streiner & Norman, 2008; Zainudin, 2012).
  - **Discriminant validity**: 1) AVE value higher than SV values (Fornell & Larcker, 1981) ; 2) A correlation between constructs of less than 0.85 (Brown, 2006).

MATERIALS & METHODS

Data Analysis

- **Reliability analysis** was performed by **SPSS** 22 to examine its **internal consistency** – **Cronbach's alpha** value **more than 0.7** is considered as **high internal consistency** (Streiner & Norman, 2008).

RESULTS

Construct Validity

- **The original three-factor CLS with 10 items achieved** acceptable values on the goodness-of-fit indices, suggesting **a good model fit.**

Table 2: The results of confirmatory factor analysis of CLS.

Variable	X^2 – statistic (df)	*p*-value	Goodness of fit indices					
			ChiSq/df	RMSEA	GFI	CFI	NFI	TLI
One-factor model[a]	295.003 (35)	<0.001	8.429	0.284	0.619	0.650	0.625	0.549
3-factor model[a]	36.885 (32)	0.253	1.153	0.041	0.929	0.993	0.953	0.991

[a] The original construct of the CLS was supported for a model fit.

RESULTS

Reliability

- CLS achieved **high internal consistency**, indicated by Cronbach's alpha more than 0.7.

Table 3: The reliability analysis of the 10 items of the CLS based on the final model.

No	Item	Standardized factor loading	[b]Domain	[a]Cronbach's Alpha	[c]AVE	[d]CR
1	The topics covered in the PBL were very complex.	0.76	Intrinsic load	0.88	0.73	0.89
2	The PBL covered terminologies that I perceived as very complex.	0.95				
3	The PBL covered concepts and definitions that I perceived as very complex.	0.84				
4	The instructions and explanations during the PBL were very unclear.	0.87	Extraneous load	0.82	0.62	0.83
5	The instructions and explanations during the PBL were full of unclear language.	0.84				
6	The instructions and explanations during the PBL were, in terms of learning, very ineffective.	0.63				
7	The PBL really enhanced my understanding of the topics covered.	0.77	Self-perceived learning	0.95	0.84	0.95
8	The PBL really enhanced my understanding of the terminologies covered.	0.91				
9	The PBL really enhanced my knowledge of concepts and definitions.	0.97				
10	The PBL really enhanced my knowledge and understanding of the subject.	0.99				

[a] Reliability analysis; Cronbach's alpha coefficient.
[b] Domains were predetermined based on a previous study.
[c] AVE (Average Variance Extracted) was calculated manually based on formula given by Fornell & Larcker.[51]

RESULTS

Convergent Validity

- **CLS achieved good convergent validity**, indicated by factor loading and AVE more than 0.5, and CR more than 0.5 (Hair et al., 2009; Streiner & Norman, 2008; Zainudin, 2012).

Table 3: The reliability analysis of the 10 items of the CLS based on the final model.

No	Item	Standardized factor loading	[b]Domain	[a]Cronbach's Alpha	[c]AVE	[d]CR
1	The topics covered in the PBL were very complex.	0.76	Intrinsic load	0.88	0.73	0.89
2	The PBL covered terminologies that I perceived as very complex.	0.95				
3	The PBL covered concepts and definitions that I perceived as very complex.	0.84				
4	The instructions and explanations during the PBL were very unclear.	0.87	Extraneous load	0.82	0.62	0.83
5	The instructions and explanations during the PBL were full of unclear language.	0.84				
6	The instructions and explanations during the PBL were, in terms of learning, very ineffective.	0.63				
7	The PBL really enhanced my understanding of the topics covered.	0.77	Self-perceived learning	0.95	0.84	0.95
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9	The PBL really enhanced my knowledge of concepts and definitions.	0.97				
10	The PBL really enhanced my knowledge and understanding of the subject.	0.99				

[a] Reliability analysis; Cronbach's alpha coefficient.
[b] Domains were predetermined based on a previous study.
[c] AVE (Average Variance Extracted) was calculated manually based on formula given by Fornell & Larcker.[51]

RESULTS

Discriminant Validity

- **CLS achieved acceptable discriminant validity,** indicated by 1) correlation between IL, EL & SPL construct less than 0.85 (Fornell & Larcker, 1981) and 2) AVE values more than SV values (Brown, 2006)

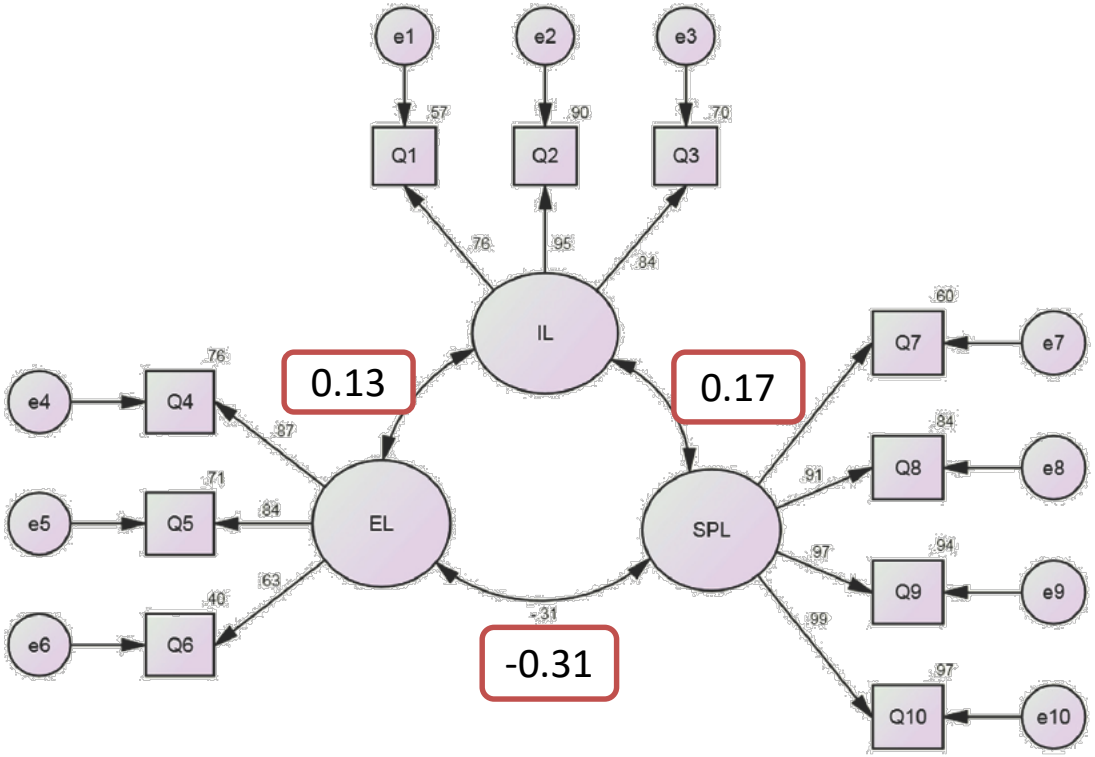


Table 4: AVE and SV of the CLS based on the final model.

Factors	AVE	SV by factor		
		IL	EL	SPL
Intrinsic load	0.73	1	0.017	0.029
Extraneous load	0.62	0.017	1	0.096
Self-perceived learning	0.84	0.029	0.096	1

Figure 2: Correlation between three CLS constructs based on the final model.

RESULTS

Table 5: The mean and standard deviation of the CLS scores.

CLS domain	N	Mean	Std. Deviation
Intrinsic load	93	6.33	1.83
Extraneous load	93	3.72	2.06
Self-perceived learning	93	7.05	1.89

IL — **Task complexity** and the **learner's prior knowledge** → **Moderate**

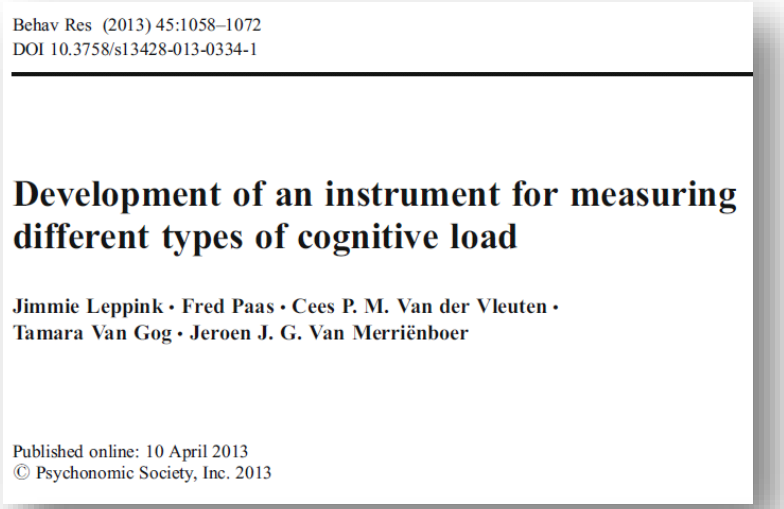
EL — **Instructional features** that are **not beneficial for learning** → **Low**

SPL — **Instructional features** that are **beneficial for learning** → **High**

DISCUSSION

INTERNAL STRUCTURE

- CLS has good:
  - ✓ **construct validity**
  - ✓ **convergent validity**
  - ✓ **discriminant validity**
- **Cronbach's alpha** values of CLS constructs ranged from **0.82 to 0.95**.
  - → **Leppink et al (2013)** reported the Cronbach's alpha ranged from **0.75 to 0.82** (statistics).
  - → **Leppink et al (2014)** reported the Cronbach's alpha ranged from **0.79 to 0.95** (statistics & language)



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Development of an instrument for measuring different types of cognitive load

Jimmie Leppink · Fred Paas · Cees P. M. Van der Vleuten · Tamara Van Gog · Jeroen J. G. Van Merriënboer

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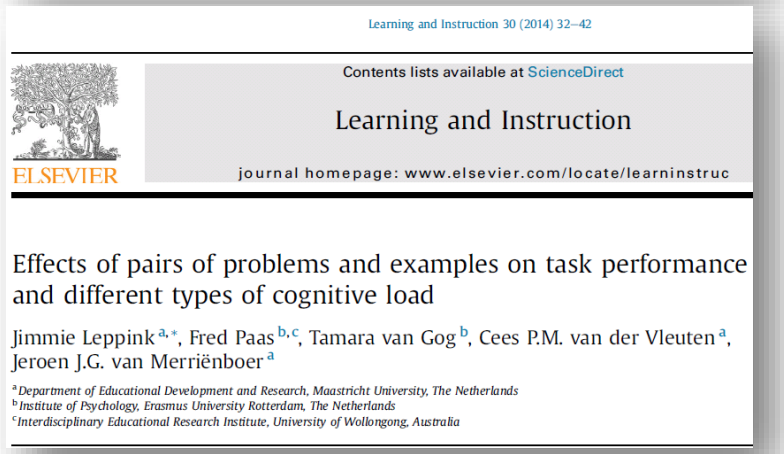

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Effects of pairs of problems and examples on task performance and different types of cognitive load

Jimmie Leppink[a,*], Fred Paas[b,c], Tamara van Gog[b], Cees P.M. van der Vleuten[a], Jeroen J.G. van Merriënboer[a]

[a] Department of Educational Development and Research, Maastricht University, The Netherlands
[b] Institute of Psychology, Erasmus University Rotterdam, The Netherlands
[c] Interdisciplinary Educational Research Institute, University of Wollongong, Australia

DISCUSSION

INTERNAL STRUCTURE

- These facts suggest **CLS has a stable validity with high internal consistency across datasets of different population**: Social & health sciences students (lecture in statistics & language); Health sciences freshman (lecture in statistics); **Medical students (PBL).**

DISCUSSION

PBL & CL

PBL imposed a moderate intrinsic load

	Anticipated	Finding
IL Task complexity and the learner's prior knowledge	Moderate to High	Moderate
EL Instructional features that are not beneficial for learning		
SPL Instructional features that are beneficial for learning		

DISCUSSION

PBL & CL

PBL imposed a low extraneous load

		Anticipated	Finding
IL	**Task complexity** and the **learner's prior knowledge**	**Moderate to High**	**Moderate**
EL	**Instructional features** that are **not beneficial for learning**	**Low to Moderate**	**Low**
SPL	**Instructional features** that are **beneficial for learning**		

DISCUSSION

PBL & CL

PBL imposed a high self-perceived learning

		Anticipated	Finding
IL	**Task complexity** and the **learner's prior knowledge**	**Moderate to High**	**Moderate**
EL	**Instructional features** that are **not beneficial for learning**	**Low to Moderate**	**Low**
SPL	**Instructional features** that are **beneficial for learning**	**Moderate to High**	**High**

DISCUSSION

PBL & CL

- These findings suggest that the **students invested more mental effort processing** the **IL than** the **EL.**
- These findings **fit the concept of PBL** because:
  → students were exposed to **complex clinical-based triggers** despite being **novices**;
  →students have **autonomy in learning** because they were able to **decide the content of discussion** and **deliver information** in a manner that could be **easily understood by their peers**;
  →students could **learn at their own pace** with the **appropriate use of** available **resources**.
- This suggests **consequence validity** of **CLS scores** in **PBL** setting → the score reflects the anticipated CL of PBL.

DISCUSSION

LIMITATIONS

- This study was **conducted at a medical school**, the findings **might not be generalizable** to other institutions.
- This study was **conducted after one PBL session**, which might **not completely reflect** the **respondents' judgments** regarding "the PBL".
- These **data assessed** the construct validity of the questionnaire merely of **its internal structure without manipulation of PBL elements** that is known to make difference in term of either the **IL** or **EL**.
- The **sample size** was **relatively small**, so the **findings should be interpreted with caution**.

DISCUSSION

IMPLICATIONS

- CLS should be **used as a diagnostic feedback** measure before making any improvisations to PBL instruction.
- **Future research** should contribute **towards a better understanding of how CLT could be adopted in PBL** without jeopardizing the concept of PBL.
- **Students' cognitive loads** should not be limited to one or several PBL sessions, but **should be measured longitudinally** across different durations.
- Further study would benefit from an **additional randomized controlled experiment** that **uses the current questionnaire** and **manipulates an element in the PBL session** (experimental vs. control condition) that **is known** to make a difference in terms of either the **IL** or **EL**.

CONCLUSION

- This study supports the **construct validity**, **reliability**, **feasibility** and **significance** of the **CLS** as a tool to **measure cognitive loads** of medical students during **PBL**.

- This study warrants the **need for more research to explore students' mental workload during PBL** session for improving PBL instruction for future implementation.

Hadie SNH, Yusoff MSB. Assessing the validity of the cognitive load scale in a problem-based learning setting. J Taibah Univ Med Sc, 2016;11(3):194-202. http://dx.doi.org/10.1016/j.jtumed.2016.04.001

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Looking forward to receive your submission.

Dr Saiful, MD, MMEd, PhD
Editor in Chief
Education in Medicine Journal

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Q&A

Thank You

msaiful_bahri@usm.my
snurma@usm.my