

# Psychometric Properties of an Instrument to Assess Students' Performance in Problem-based Learning Tutorials

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**TUTORIAL GROUPS ARE ESSENTIAL TO STUDENTS' LEARNING PROCESSES<sup>1</sup>**

The way students **participate and are involved** in PBL tutorials affect the **activation** of these learning principles and therefore students' **deep learning<sup>2</sup>**

Evaluating students' behavior in PBL tutorial groups is crucial for promoting students' **activation of these learning processes<sup>3</sup>**

The instrument showed **good reliability** in terms of intra-class correlation coefficient (ICC) and the ability to discriminate between **strict and indiscriminate tutors<sup>4</sup>**

**CONSTRUCTIVE**

**CONTEXTUAL**

**COLLABORATIVE**

**SELF-DIRECTED LEARNING**

The present study aims to extend the previous findings on the instrument's psychometric properties by further analyzing a measure of **external validity** by assessing the correlations between **students' performance in PBL tutorial groups** and their **final exam marks** in different blocks.

	PARTICIPATION AND COMMUNICATION SKILLS	COOPERATION / TEAM-BUILDING SKILLS	UNDERSTANDING / REASONING SKILLS	KNOWLEDGE / SOURCES SKILLS
1	<ul style="list-style-type: none"> <li>Does not respond to verbal / non-verbal cues from others</li> <li>Does not speak or listen to others or only to tutor</li> </ul>	<ul style="list-style-type: none"> <li>Does not contribute to learning issues (PRE/POST)</li> <li>Does not give others the opportunity to speak or interrupts others</li> <li>Unwilling to acknowledge others' views or take up any task</li> </ul>	<ul style="list-style-type: none"> <li>Does not demonstrate understanding of basic (biological, behavioural and/or populational) concepts</li> <li>Does not seek clarification of concepts</li> </ul>	<ul style="list-style-type: none"> <li>Has no recall of previous knowledge (mainly PRE)</li> <li>Not prepared for session (POST)</li> </ul>
2	<ul style="list-style-type: none"> <li>Doesn't participate but interested (listen / look ) (if doesn't participate and not interested → 1)</li> </ul>	<ul style="list-style-type: none"> <li>Rarely participates in identifying learning issues</li> <li>Takes up task only when asked to by the others</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrate understanding with considerable guidance</li> <li>Rarely seeks clarification of concepts</li> </ul>	<ul style="list-style-type: none"> <li>Has limited recall of previous knowledge</li> <li>Prepared for only certain learning issues.</li> </ul>
3	<ul style="list-style-type: none"> <li>Occasionally asks questions</li> <li>Responds to verbal / non-verbal cues</li> <li>Occasionally presents ideas clearly</li> <li>Discussion or description can sometimes be understood by others</li> </ul>	<ul style="list-style-type: none"> <li>Volunteers to perform tasks (e.g. scribe, group leader, read case)</li> <li>Participates in some learning issues (PRE/POST)</li> <li>Pays attention to group / Frame topics in discussion</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrate understanding with little guidance</li> <li>Draws reasonable conclusions from given data or information</li> <li>Often seeks clarification of concepts</li> </ul>	<ul style="list-style-type: none"> <li>Applies previous knowledge to current issues sometimes (PRE)</li> <li>Prepared for some learning goals, LGs (POST)</li> </ul>
4	<ul style="list-style-type: none"> <li>Often presents ideas clearly</li> </ul>	<ul style="list-style-type: none"> <li>Participates in identifying most learning issues</li> <li>Encourage others to participate</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrates understanding clearly</li> <li>Identifies flaws in data / reasoning (pointed by others)</li> </ul>	<ul style="list-style-type: none"> <li>Well prepared for session (mostall LG) and applied previous knowledge</li> </ul>
5	<ul style="list-style-type: none"> <li>Constantly asks questions that stimulate discussion and</li> <li>Constantly presents ideas clearly with demonstration of summarizing skills</li> </ul>	<ul style="list-style-type: none"> <li>Asks/gives feedback from/to the group</li> <li>Participates in most learning issues, and helps to prioritise learning issues</li> <li>Organises the group</li> <li>Shows empathy</li> <li>Tries to bring quiet members into discussion in a diplomatic manner (invite quiet members more directly →4)</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrates understanding clearly ( → 4)</li> <li>Ability to understand others' doubts and provide clear clarification</li> <li>Integrates difficult concepts</li> <li>Regularly applies biological with behavioral and population perspectives</li> <li>Identifies flaws in data / reasoning independently</li> </ul>	<ul style="list-style-type: none"> <li>Well prepared for session and applied previous knowledge</li> <li>Identifies key sources, acknowledge reliability, relevance and purpose (discards unreliable, combine major and minor, starts by "quick" videos but don't miss "complete"/textbooks )</li> </ul>

Figure 1. Instrument to assess students' performance in PBL tutorials, by Sim et al., 2006.

### Sample characteristics:

- 139 students and 46 tutors from an Integrated Master in Medicine
- 8 blocks (7 from year I and 1 from year II)
- Full PBL curriculum, implemented for the first time, in a private Medical School

### Data Collection Methods:

- Students were individually assessed by their tutors throughout the blocks on each of the four dimensions of the instrument described by Sim et al. (2006) (Figure 1)
- Data were collected in academic years of 2021/2022 and 2022/2023
- At the end of each block, each student received a final grade for each dimension and an overall grade of his/her overall performance in the tutorial group

## Findings

- Correlations between PBL tutorials' grade in each of four dimensions and block exam score
- Correlations between PBL tutorial grades and block exam score

### Block Information

BLOCK	YEAR	PBL WEIGHT IN THE FINAL GRADE	BLOCK TEST WEIGHT IN THE FINAL GRADE	DURATION	N
1	2021/2022	0%	65%	8 weeks	N=55
2	2021/2022	10%	70%	8 weeks	N=55
3	2021/2022	35%	65%	4 weeks	N=56
4	2021/2022	20%	60%	8 weeks	N=56
5	2021/2022	20%	60%	8 weeks	N=56
6	2021/2022	15%	70%	4 weeks	N=56
7	2022/2023	10%	60%	8 weeks	N=83
8	2022/2023	20%	60%	8 weeks	N=48

### PBL Tutorials Global Final Grades X Block Exams Grade (Spearman Correlations)

BLOCK	PARTICIPATION AND COMMUNICATION SKILLS	COOPERATION / TEAM-BUILDING SKILLS	COMPREHENSION AND REASONING SKILLS	KNOWLEDGE AND INFORMATION GATHERING SKILLS	GLOBAL GRADE
1	0.468**	0.394	0.604**	0.619**	-
2	0.173	0.210	0.191	0.172	0.172
3	0.446	0.332	0.421	0.405	0.457*
4	0.383	0.320	0.328	0.285	0.374*
5	0.090	0.121	0.142	0.252	0.381*
6	0.387	0.351	0.385	0.460*	0.391*
7	0.199	0.218	0.248	0.312	0.263*
8	0.309	0.323	0.283	0.402	0.369**

\*\* Correlation is significant at the 0.01 level (2-tailed).  
\* Correlation is significant at the 0.05 level (2-tailed).

## Discussion

- Weak correlations between students PBL tutorials and exams grades can suggest **problems of validity** of the presented instrument, as we conceptualized this relation as a measure of **external validity**.
- However, this conclusion should be looked cautiously. It may be the case that what is being **assessed in PBL tutorials** (e.g., reasoning, and contextualized knowledge) **differs from what is being assessed in the final exams** (e.g., mainly declarative knowledge).
- This possibility is in line with previous research according to which PBL tutorials' **good experiences** reported by students are **not reliable indicators of better academic outcomes<sup>5</sup>**.
- A **higher associations** between dimensions 3 and 4 of students' performance in tutorial groups and their exams grades when students' PBL tutorial grades have (a) **no impact on the final grade of the block** (block 1); (b) a **bigger impact on the final grade of the block** (block 3).

## Go to Work Messages

Future research should be developed to understand better:

- The **lack of stronger relations** between students' participation in PBL tutorials and their performance in final exams.
- What can explain the **moderate correlations** found in block 1.
- What can explain the **weak significant positive** correlation found in block 3.

### References

- Dolmans, D.H.J.M. How theory and design-based research can mature PBL practice and research. *Adv in Health Sci Educ*. 2019; 24:879-891.
- Wijnen, M., Loyens, S.M.M., Smeets, G. et al. Comparing problem-based learning students to students in a lecture-based curriculum: learning strategies and the relation with self-study time. *Eur J Psychol Educ* 32, 431-447 (2017). <https://doi.org/10.1007/s10212-016-0296-7>
- Dolmans DH, Wolfhagen HA, Scherpbier AJ. From quality assurance to total quality management: how can quality assurance result in continuous improvement in health professions education? *Educ Health (Abingdon)*. 2003;16(2):210-217.
- Sim SM, Azila NM, Lian LH, Tan CP, Tan NH. A simple instrument for the assessment of student performance in problem-based learning tutorials. *Ann Acad Med Singap*. 2006; 35:634-641.
- Li, A., Bilgic, E., Keuhl, A. et al. Does your group matter? How group function impacts educational outcomes in problem-based learning: a scoping review. *BMC Med Educ* 22, 900 (2022). <https://doi.org/10.1186/s12909-022-03966-8>