

Motives and Methods for Differentiating Student Confidence and Certainty in Knowledge Assessments

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ABSTRACT

PURPOSE: Knowledge is learned information that is *true and justified*; it is multidimensional. Knowledge assessments that evaluate response trueness (*i.e.*, correctness) and justification can accurately detect all knowledge levels. Evaluating response justification involves comparing what students *think* they know to what they *actually* know. Despite their distinctions, student confidence and certainty have been used interchangeably as response justifications. The objective of the present study is to investigate whether there are critical differences between student confidence and certainty in knowledge assessment.

METHODS: A literature review was conducted to ensure comprehensive analysis, substantiate working postulations, assemble best fit term meanings, and compare student confidence and certainty. A customized questionnaire will be administered to students to survey and compare their interpretations of confidence and certainty.

RESULTS: *Confidence* refers to a student's degree of belief in their ability to provide a correct response to an assessment item (given some frame of reference for what the item will concern and entail), and *certainty* refers to a student's degree of belief in that their response to an assessment item is correct. Both are examples of student metacognition assessed by prompts for self-reflection but evaluated at considerably different times (before vs. during assessment item presentation). Accordingly, confidence contributes to determining the likelihood of students applying learned information to skills and decision-making, whereas certainty validates information acquisition and correctness by illustrating whether correct and incorrect responses are the result of complete, partial, absent, or flawed knowledge.

CONCLUSIONS: This study reveals that student confidence and certainty share similar metacognitive origins and assessment formats but exhibit critically different, independent roles in assessing knowledge and timings of evaluation. Certainty is proper for justifying assessment item responses in knowledge assessments. Differentiating student confidence and certainty may improve knowledge assessment efficacy, inform other strategies for enhancing knowledge assessments, and benefit student learning and long-term knowledge retention.

INTRODUCTION

Since knowledge is multidimensional, the conventional, single-dimensional “number correct” assessment method presents many limitations for accurately assessing knowledge as it only considers correctness of student responses to interpret knowledge.^{1,2} Disregarding students' justifications for their responses to assessment items leaves educators unable to conclude whether a correct response is the result of complete, partial, or absent knowledge and whether an incorrect response is the result of partial, absent, or flawed knowledge.³ To overcome these limitations, educator-scholars have developed methods for assessing both dimensions of knowledge – correctness *and* justification. One method prompts students to report how confident they are in that each of their chosen or constructed responses is correct. By comparing what students *think* they know (a metacognitive justification) to what they *actually* know (determined by response correctness), these “Confidence-Based Assessments” enable educators to accurately assess all levels of knowledge.^{4,5} As Confidence-Based Assessments were further utilized, some authors believed *certainty* was a more appropriate term for achieving what was previously intended with the term *confidence*, and as a result the name of these assessments was appropriately changed to “Certainty-Based Assessments.”⁶ This modification did not discredit previous studies' outcomes though, and many credible studies have since used *confidence* in place of *certainty* in this way in other versions of this assessment method. These findings shaped the present study's objective to investigate whether critical differences exist between the roles of student confidence and certainty in assessing knowledge. The authors hypothesizes the terms' contrasts will translate to significant motives for differentiating them in knowledge assessments.

METHODS

- 1) Noted differences between student confidence and certainty discovered from the author's past study of confidence/certainty-based assessments were compiled and further analyzed.
- 2) A literature review was conducted for completeness and to substantiate working postulations.
- 3) Best fit meanings for student confidence and certainty (relative to knowledge assessment) were constructed from consistencies in accumulated information.
- 4) The terms were scrutinized for comparability in their meanings, motives for use, and methods of evaluation in knowledge assessments.

*5) Students' perceptions of confidence and certainty in regard to knowledge assessments were surveyed with a customized questionnaire administered via Qualtrics online survey software.

*6) Agreement between this study's findings and student perceptions were analyzed and discussed.

*Complications from the COVID-19 pandemic delayed completion of these methods. The authors plan to complete these methods when able.

RESULTS

Confidence

Meaning: a student's degree of belief in their ability to provide a correct response to an assessment item (given some frame of reference for what the item will concern and entail).

Motive for Use: as a contributing factor for determining the likelihood of that student applying learned information (correct and validated, or not) to skills and decision-making (*i.e.*, **competence**).

Method of Evaluation: as a prompt for self-assessment before the associated assessment item(s) is/are presented to the student. **For example:**

Pre-Item Self-Assessment:

How **confident** are you in your ability to correctly identify innervations of muscles of the arm (Learning Objective 4B)?

- ☐ Very confident
- ☐ Somewhat confident
- ☐ Not at all confident

Certainty

Meaning: a student's degree of belief in that their chosen or constructed response to an assessment item is correct.

Motive for Use: as a validation of information acquisition and correctness; it discriminates absent knowledge (specifically in the rarer form of **wild guesswork** that results in a correct response) from otherwise being considered complete knowledge (*i.e.*, **mastery**), discerns flawed knowledge (*i.e.*, **misinformation**) from absent knowledge, and identifies when partial knowledge (**educated guesswork**) is evident (see Figure 1).

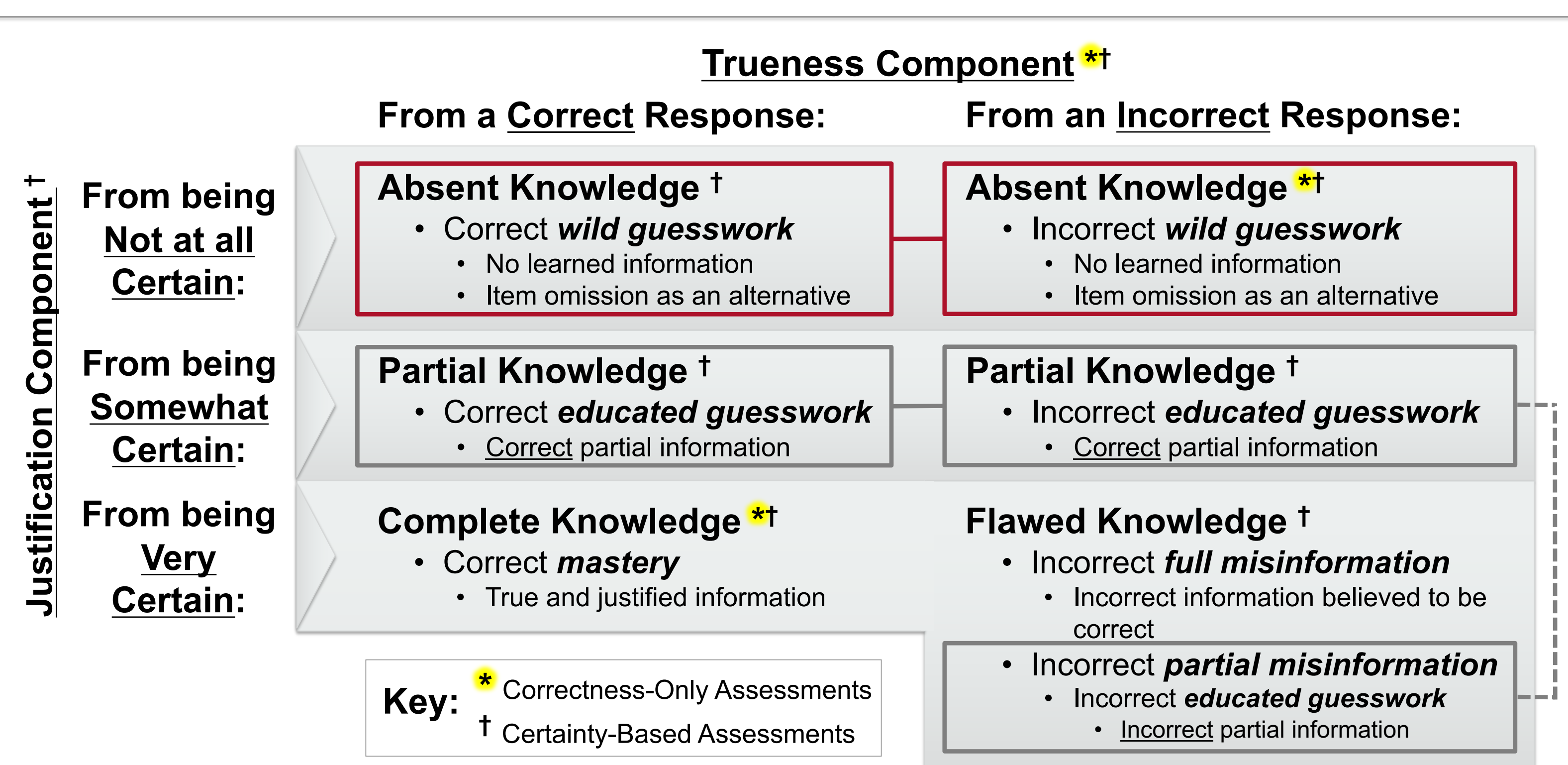


Figure 1. Knowledge Interpretations from Correctness-Only and Certainty-Based Assessment Methods. Correctness-only assessments are only able to interpret complete and absent knowledge from correct and incorrect responses, respectively. However, a correct response can be the result of complete, partial, or absent knowledge, and an incorrect response can be the result of partial, absent, or flawed knowledge. Both absent and partial knowledge can be represented by correct and incorrect responses to assessment items (red and dark gray boxes, respectively). Certainty-based assessments differentiate absent and partial knowledge from complete knowledge, and partial and flawed knowledge from absent knowledge. Partial knowledge can be both true and flawed.

Method of Evaluation: as a prompt for self-assessment at the time a student responds to an assessment item. **For example:**

Assessment Item:

What peripheral nerve innervates the biceps brachii muscle?

- ☐ Musculocutaneous n.
- ☐ Axillary n.
- ☐ Radial n.

How **certain** are you in that your chosen answer is correct?

- ☐ Very certain
- ☐ Somewhat certain
- ☐ Not at all certain

Confidence vs. Certainty

- | | |
|----------------------|---|
| Similarities: | 1) Both are elements of metacognition
2) Both are evaluated via similar formats (as prompts for self-assessment) |
| Differences: | 1) Their subjects for metacognitive reflection
2) Their motives for use in assessing knowledge
3) Their timing of evaluation in knowledge assessments |

Student Perceptions

Due to complications from the COVID-19 pandemic, the authors were unable to collect students' perceptions of confidence and certainty as originally planned. Agreement in these surveyed responses was going to be used to validate the authors' postulations. The authors still plan to collect this data when able as the study continues to progress.

DISCUSSION AND CONCLUSIONS

Put simply, the purpose of this study is to investigate suspected conflicts in metacognition terminology used interchangeably in multidimensional knowledge assessment methods. Based on over five years of previous study, consistencies in the literature, and a scrutinous comparison of the core terms' meanings, motives for use, and methods of evaluation, the authors conclude that though confidence and certainty have obvious core similarities, they exhibit critically different roles in assessing knowledge. Confidence is proper for metacognitive pre-item self-assessment of ability, whereas certainty is proper for justifying assessment item responses in knowledge assessments. An agreement analysis of student perceptions of confidence and certainty will help validate these conclusions. The fundamental principles outlined in this study will shape this project's continued development and pilot study implementation.

Planned Future Directions:

- 1) As described, we first plan to survey students of their perceptions of confidence and certainty. We will compare their perceptions to our postulations based on the literature and core principles.
- 2) We plan to complete another methods-based study focused specifically on distinguishing partial misinformation from partial information using these multidimensional assessment method principles. Partial knowledge results in educated guesswork, producing better odds than wild guesswork *only if the correct answer in whole or part was not eliminated*. If in fact all or part of the correct answer was eliminated, partial misinformation would result and should be distinguishable from partial information.
- 3) Having investigated the differentiation between student confidence and certainty in knowledge assessment, we plan to investigate the idea of simultaneously using both in their specific roles to more accurately assess knowledge and even make future performance predictions. To do this, we intend to establish:
 - a. a manageable pilot study cohort to collect real data,
 - b. a program to collect, manage, and analyze the data,
 - c. and a scale for grading the multidimensional performances.

Distributing motives and methods for differentiating student confidence and certainty may help educators improve knowledge assessments and enhance student knowledge retention.

REFERENCES

1. Hunt, D. P. The Concept of Knowledge and How to Measure It. *J. Intellect. Cap.* **4**, 100–113 (2003).
2. Adams, T. M. & Ewen, G. W. The Importance of Confidence in Improving Educational Outcomes. in *University of Wisconsin System's 25th Annual Conference on Distance Teaching and Learning* (2009).
3. Ben-Simon, A. *et al.* Comparative Study of Measures of Partial Knowledge in Multiple-Choice Tests. *Appl. Psychol. Meas.* **21**, 65–88 (1997).
4. Gardner-Medwin, A. R. & Gahan, M. Formative and Summative Confidence-Based Assessment. in *Proceedings of the 7th CAA Conference* 147–155 (2003).
5. Gardner-Medwin, A. Confidence-Based Marking; Towards Deeper Learning and Better Exams. In: Bryan, C. and Clegg, K. (eds.) *Innovative Assessment in Higher Education*. 141–149 (Routledge, Taylor and Francis Group, 2006).
6. Gardner-Medwin, A. & Curtin, N. Certainty-Based Marking (CBM) for Reflective Learning and Proper Knowledge Assessment. *Proceedings of the REAP Int. Online Conference on Assessment Design for Learner Responsibility* (2007).

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