

Today's webinar

The challenges of assessing critical thinking

What is critical thinking?

Do we need to explicitly teach critical thinking?

What are some best practices when it comes to teaching and assessing students' critical thinking skills?

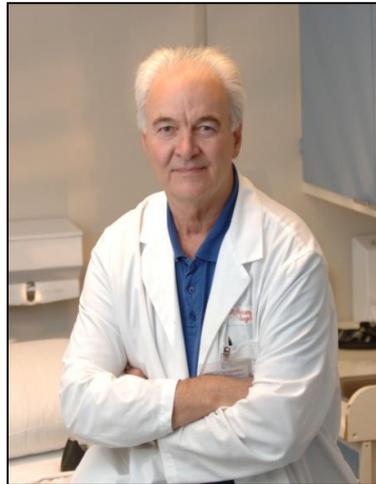


Meet today's experts



Ruth Rodgers is an Educational Development Consultant with over thirty years of experience in teaching and developing faculty in the post-secondary environment.

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Pat Croskerry is a Professor in Emergency Medicine and Director of the Critical Thinking Program at Dalhousie Medical School in Halifax, Nova Scotia.

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Brian Frank is the Director of Program Development in the Faculty of Engineering and Applied Science at Queen's University, and co-lead on a HEQCO project that is measuring critical thinking development.

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Ruth Rodgers, B.A., B.Ed., M.C.E.

Educational Development Consultant

Why critical thinking?

Information ubiquitous and overwhelming in quantity—changes our role.

Must teach students to

- ask the right questions;

- seek out answers from varied sources;

- assess the validity of the answers;

- apply the answers to unique problems.

Why is this important now?

Current parenting styles

Extended childhood

% of students in post-secondary

VS

Modern career requirements

The challenges of developing critical thinking ability

Requires overt teaching and much practice = time

Facile acceptance of shallow reasoning

Pace of life/learning

Consumer mentality

Distractions and limitations

Theory vs practice

Critical thinking can be

- analytical or persuasive in the realm of theory
- applied and practical in the realm of problem solving

Critical thinking requires both

- analysis (breaking apart)
- synthesis (putting together)

Both university and college settings require both types of critical thinking.

What does critical thinking look like?

Successful critical thinking can be judged by its results:

- problem definition;
- resources/opinions/solutions from credible and relevant sources;
- source material judged in context;
- conclusion integrates source material but responds to uniqueness;
- conclusion successfully addresses the presenting problem or question.

How is critical thinking taught?

- Defining the problem
 - overt teaching by example and practice
- Seeking resources
 - search processes and criteria
- Judging resources
 - logical fallacies/cognitive biases/thinking exercises
 - discipline-specific credentials or measures
 - case studies, class exercises, librarian assistance
- Applying resources/problem solving
 - case studies, group projects, applied research, charettes
 - essays, reports, debates, presentations

How is critical thinking evaluated?

- Formative assessment
 - professor feedback on interim steps
 - proposals, resource lists, progress reports, project outlines
 - peer review and practice opportunities
 - debates, round tables, traveling files
 - rubric includes “evidence of critical thinking”
- Summative evaluation
 - against criteria specific to task PLUS evidence of critical thinking

Sample project: persuasive presentation

- *Hero's Journey* course
 - *Star Wars, Lord of the Rings, Harry Potter*
- Literary elements (plot, setting, theme, character)
- Determine whether the FILM or BOOK version of the chosen title fulfills the literary element better
 - proposal with preliminary resource list and thesis (analysis)
- Select evidence to defend your thesis
 - Assess validity of source material: fans, critics, filmmakers, authors (analysis)
 - progress report with refined thesis statement, project outline, and finalized bibliography (synthesis)
- Generate a multi-media presentation supporting your point of view (synthesis)

Follow-up: open book exam

All presentations posted

Exam questions given one week ahead

One potential question (analysis + synthesis):

In what ways does the medium of modern film enable filmmakers to exceed the literary potential of a book? In what ways is the medium of film a limitation of an author's expression? Draw upon all three of our target stories to support your response, and integrate the work of your fellow students from their posted presentations.

Final thoughts

Both overt and embedded.

Must master the steps and techniques of critical thinking.

Must be modeled and practiced repeatedly.

Formative and summative evaluation needed.

Requires willingness to be vulnerable, flexible, open to risk, from both teacher AND student.

Critical Thinking
at
Dalhousie Medical School

Pat Croskerry MD, PhD, FRCP(Edin)

HEQCO Webinar

Nov 26 2015

The most important thing that doctors
do is diagnosis

Diagnostic Failure

15%

Estimated number of
preventable hospital deaths due
to diagnostic failure annually in
the US

Estimated number of
preventable hospital deaths due
to diagnostic failure annually in
the US

40,000 – 80,000

Leape, Berwick and Bates JAMA 2002

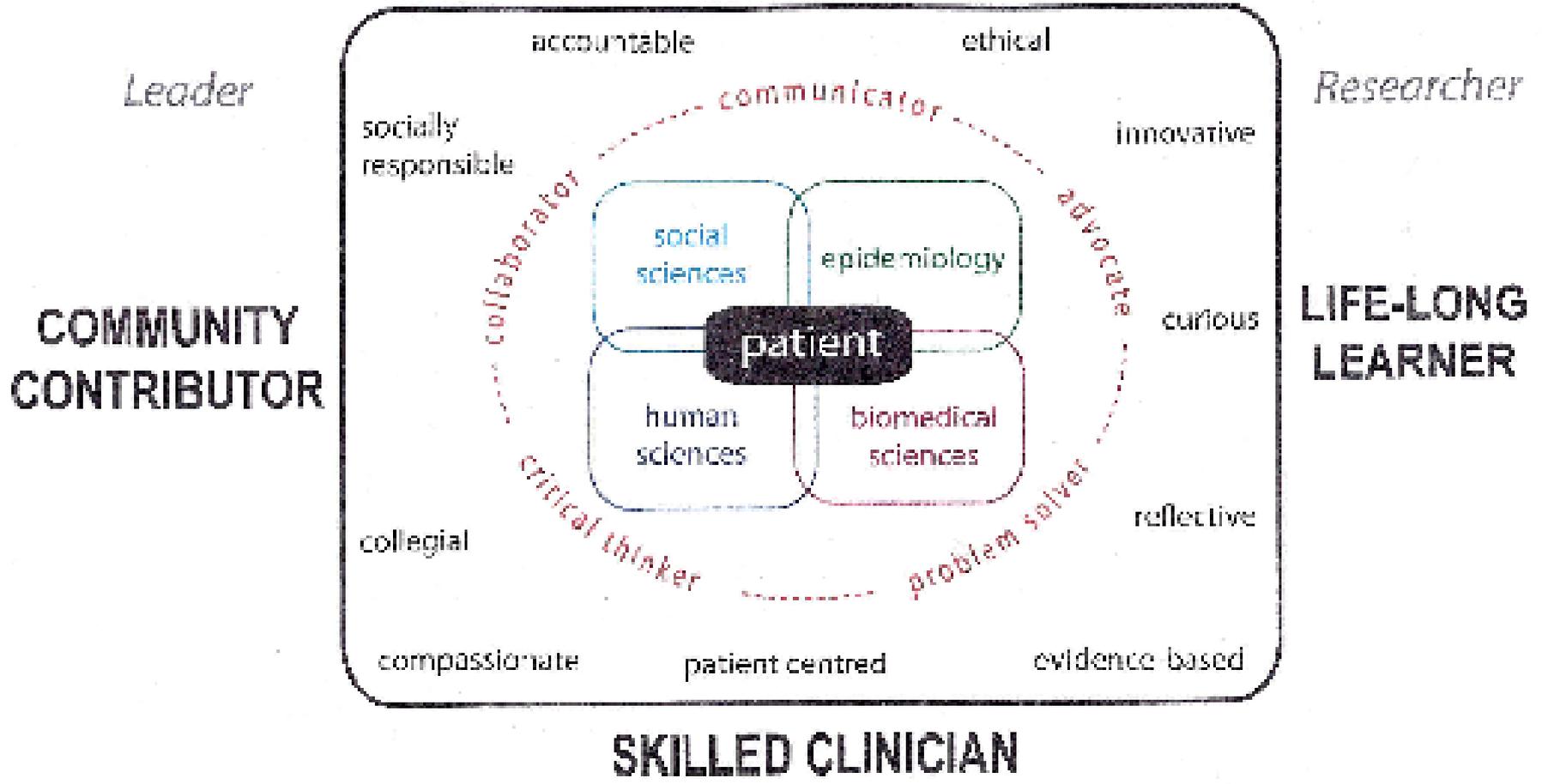
Why does misdiagnosis occur?

- The system (25%)
- The individual (75%)

Individual

- Doesn't try hard enough
- Doesn't know enough
- Doesn't think right

PROFESSIONAL



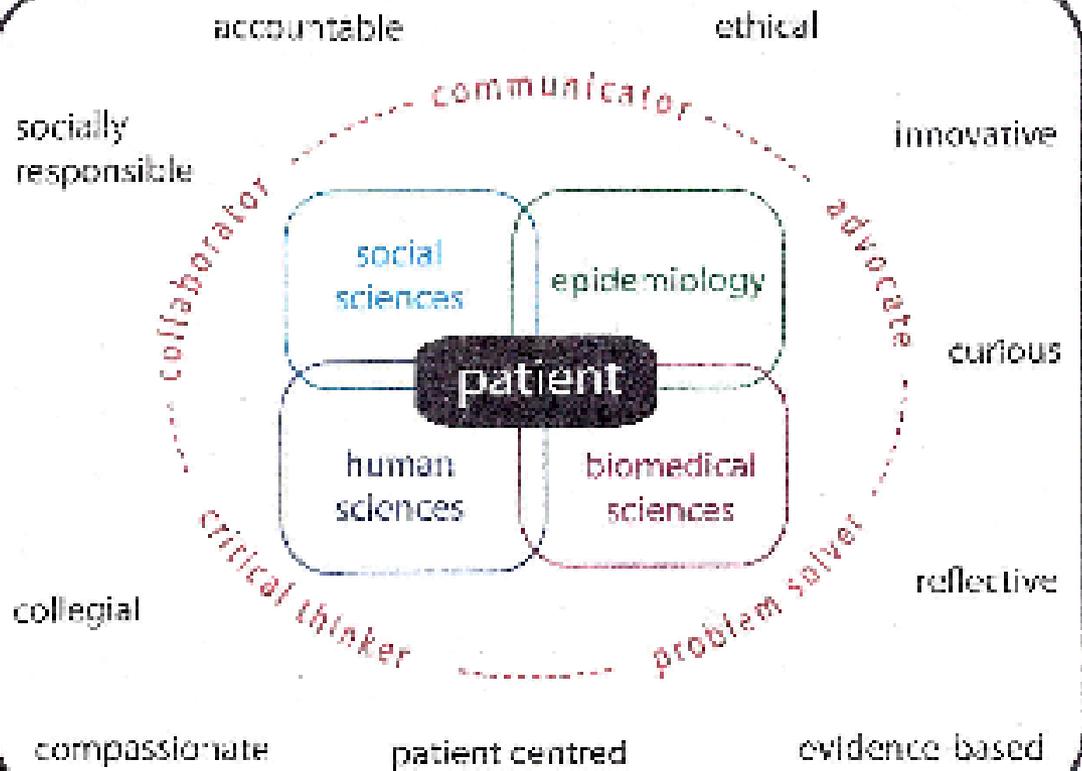
Researcher

LIFE-LONG LEARNER

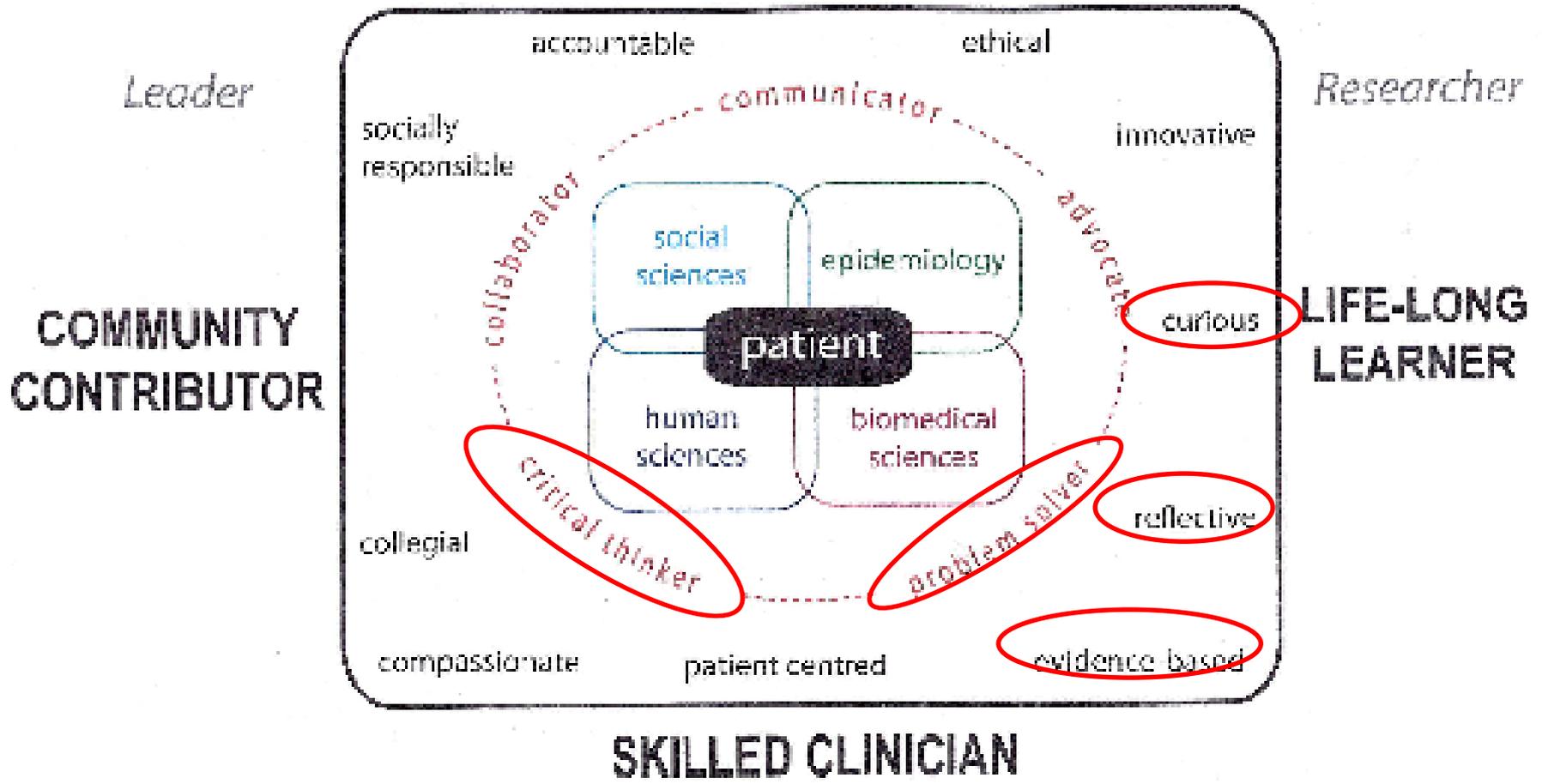
SKILLED CLINICIAN

COMMUNITY CONTRIBUTOR

Leader



PROFESSIONAL



Leader

Researcher

COMMUNITY CONTRIBUTOR

LIFE-LONG LEARNER

SKILLED CLINICIAN



How Doctors Think

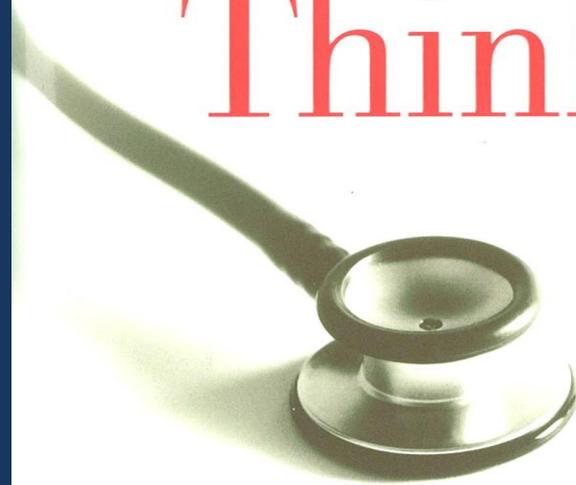
Clinical Judgment
and the Practice of Medicine

KATHRYN MONTGOMERY

"A unique, important, and wonderful book... You'll never look at your own doctor in the same way again."

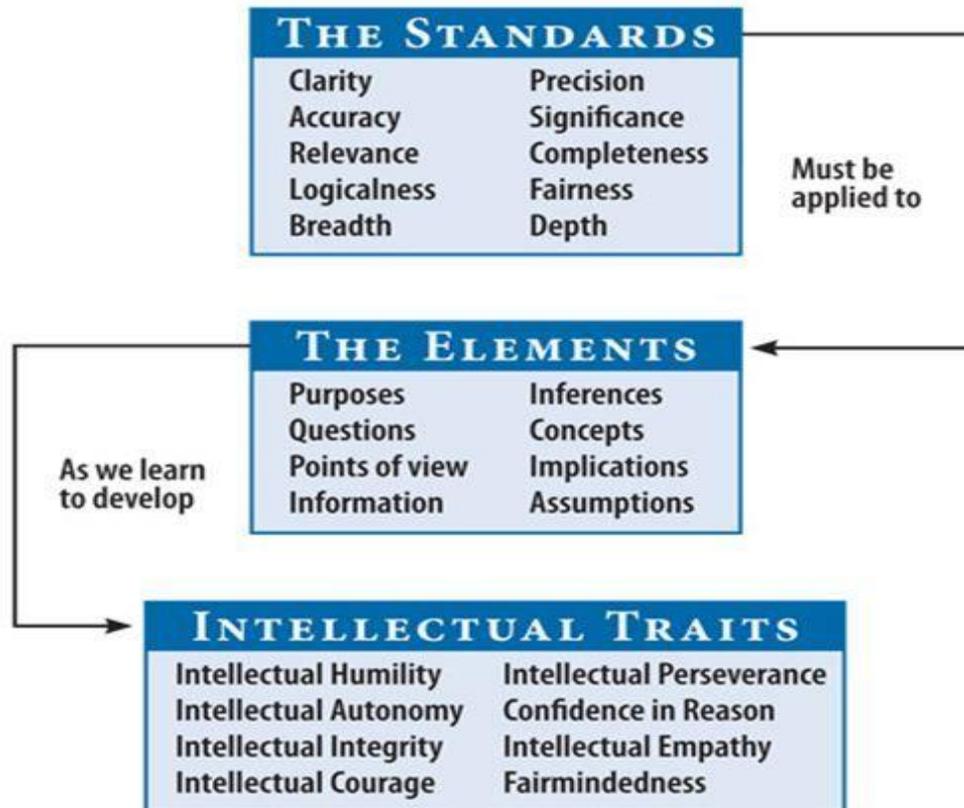
— Steven D. Levitt and Stephen J. Dubner, authors of *Freakonomics*

How Doctors Think



JEROME GROOPMAN, M.D.

Critical Thinkers Routinely Apply Intellectual Standards To The Elements Of Reasoning In Order To Develop Intellectual Traits



The Stages of Critical Thinking



- **Stage One:** The Unreflective Thinker
- **Stage Two:** The Challenged Thinker
- **Stage Three:** The Beginning Thinker
- **Stage Four:** The Practicing Thinker
- **Stage Five:** The Advanced Thinker
- **Stage Six:** The Accomplished Thinker

Elder and Paul, 2010



The Critical Thinking Program at Dalhousie Medical School

CT stages at Dalhousie

- ❑ Stage 1: by the end of Med 1
- ❑ Stage 2: by the end of Med 2
- ❑ Stage 3: between Med 3 and Med 4

Do critical thinkers actually
make better decisions?

Do critical thinkers actually
make better decisions?

YES!

Can you teach it?

UK Thinking Skills Review Group (2005)

- Examined 6500 sources – chapters, articles, papers
- Age range 5-16yrs
- 191 had all necessary information
- 23 identified as ‘highly relevant’- in depth analysis

Results

- Majority of interventions- positive impact
- None reported a negative impact
- Effect relatively greater than most other researched educational interventions

Results

CT skills programmes and approaches improved performance on tests of cognitive measures with an overall effect size of 0.62.

This effect would move a class ranked at 50th place in a league table of 100 similar classes to 26th or a percentile gain of 24 points

*Normal,
Bell-shaped Curve*

Percentage of
cases in 8 portions
of the curve

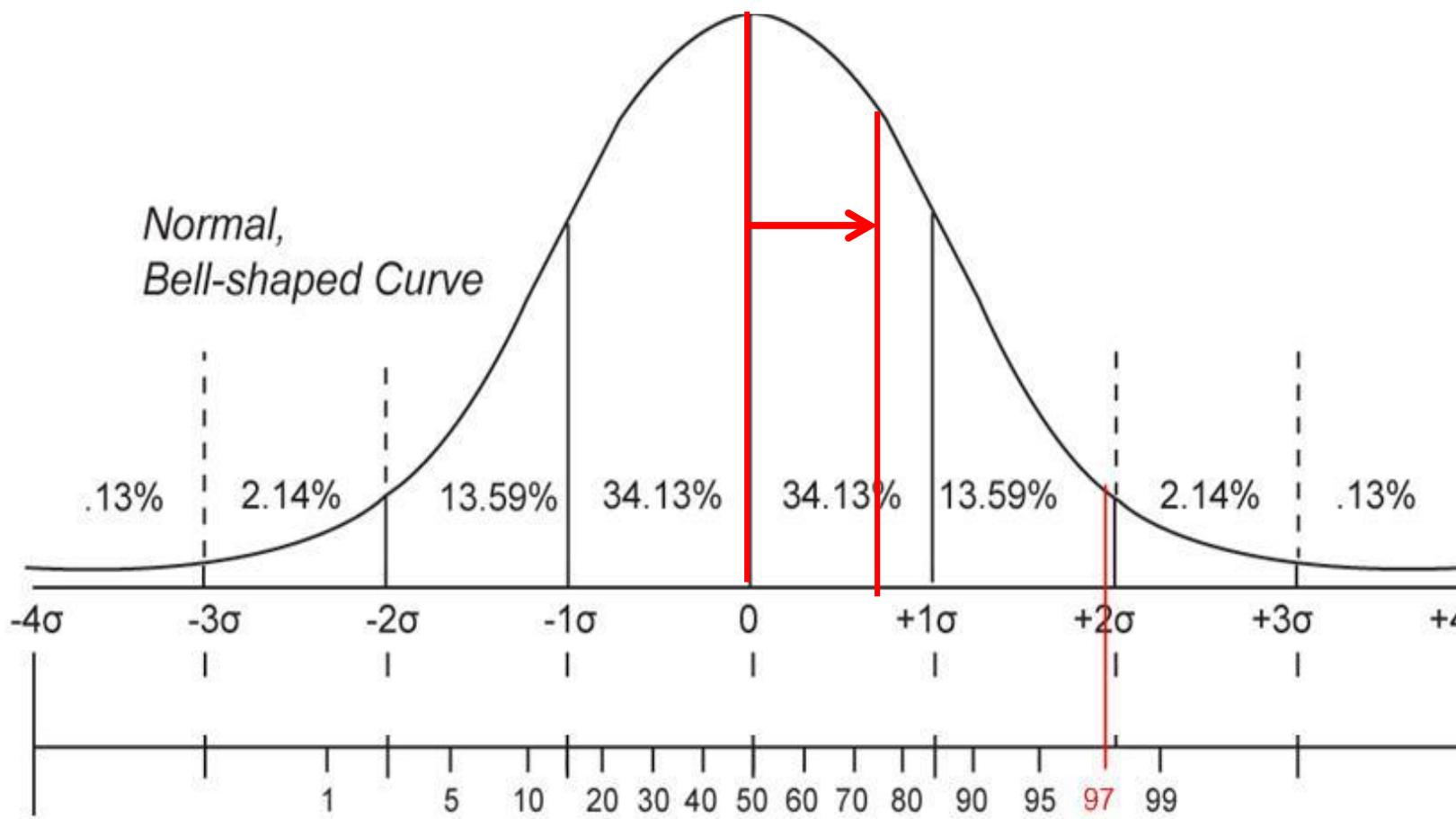
.13% 2.14% 13.59% 34.13% 34.13% 13.59% 2.14% .13%

Standard Deviations

-4σ -3σ -2σ -1σ 0 $+1\sigma$ $+2\sigma$ $+3\sigma$ $+4\sigma$

Percentiles

1 5 10 20 30 40 50 60 70 80 90 95 97 99



Integrated approach

- ❑ Undergraduate curriculum
- ❑ Tutor and Instructor development
- ❑ Postgraduate training
- ❑ Faculty development
- ❑ Continuing Medical Education

The Ethical Imperative to Think about Thinking

Diagnostics, Metacognition, and Medical Professionalism

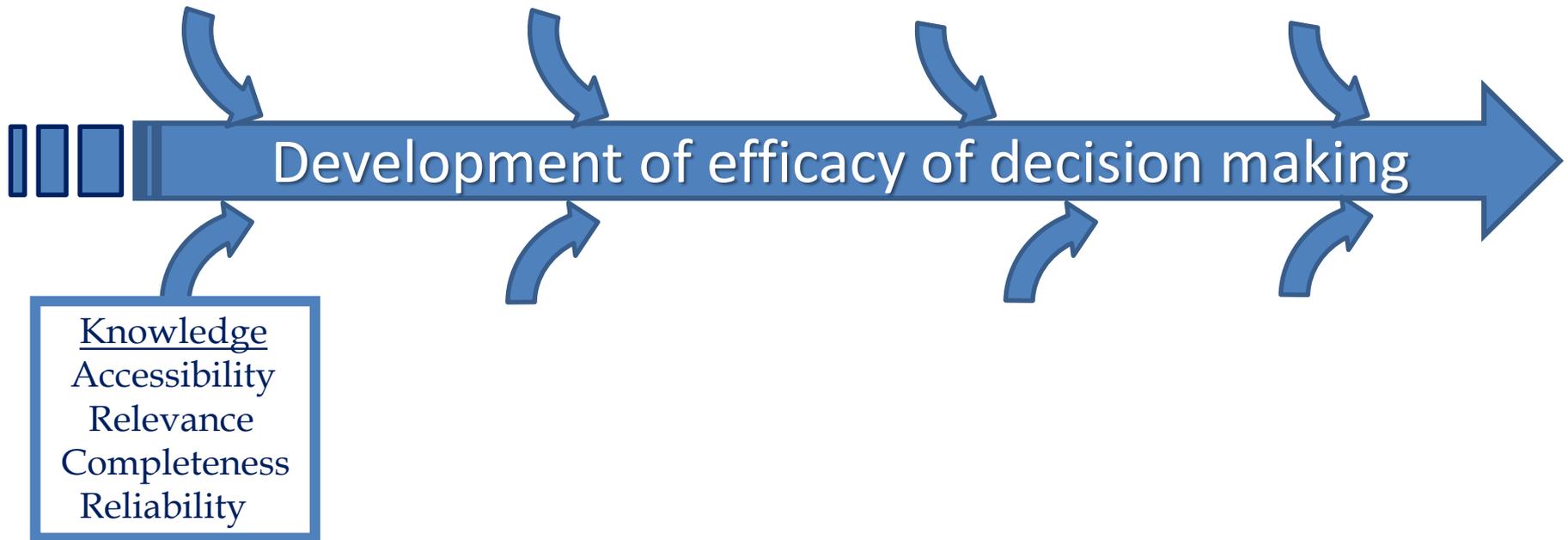
MEREDITH STARK and JOSEPH J. FINS

Abstract: While the medical ethics literature has well explored the harm to patients, families, and the integrity of the profession in failing to disclose medical errors once they occur, less often addressed are the moral and professional obligations to take all available steps to prevent errors and harm in the first instance. As an expanding body of scholarship further elucidates the causes of medical error, including the considerable extent to which medical errors, particularly in diagnostics, may be attributable to cognitive sources, insufficient progress in systematically evaluating and implementing suggested strategies for improving critical thinking skills and medical judgment is of mounting concern. Continued failure to address pervasive thinking errors in medical decisionmaking imperils patient safety and professionalism, as well as beneficence and nonmaleficence, fairness and justice. We maintain that self-reflective and metacognitive refinement of critical thinking should not be construed as optional but rather should be considered an integral part of medical education, a codified tenet of professionalism, and by extension, a moral and professional duty.

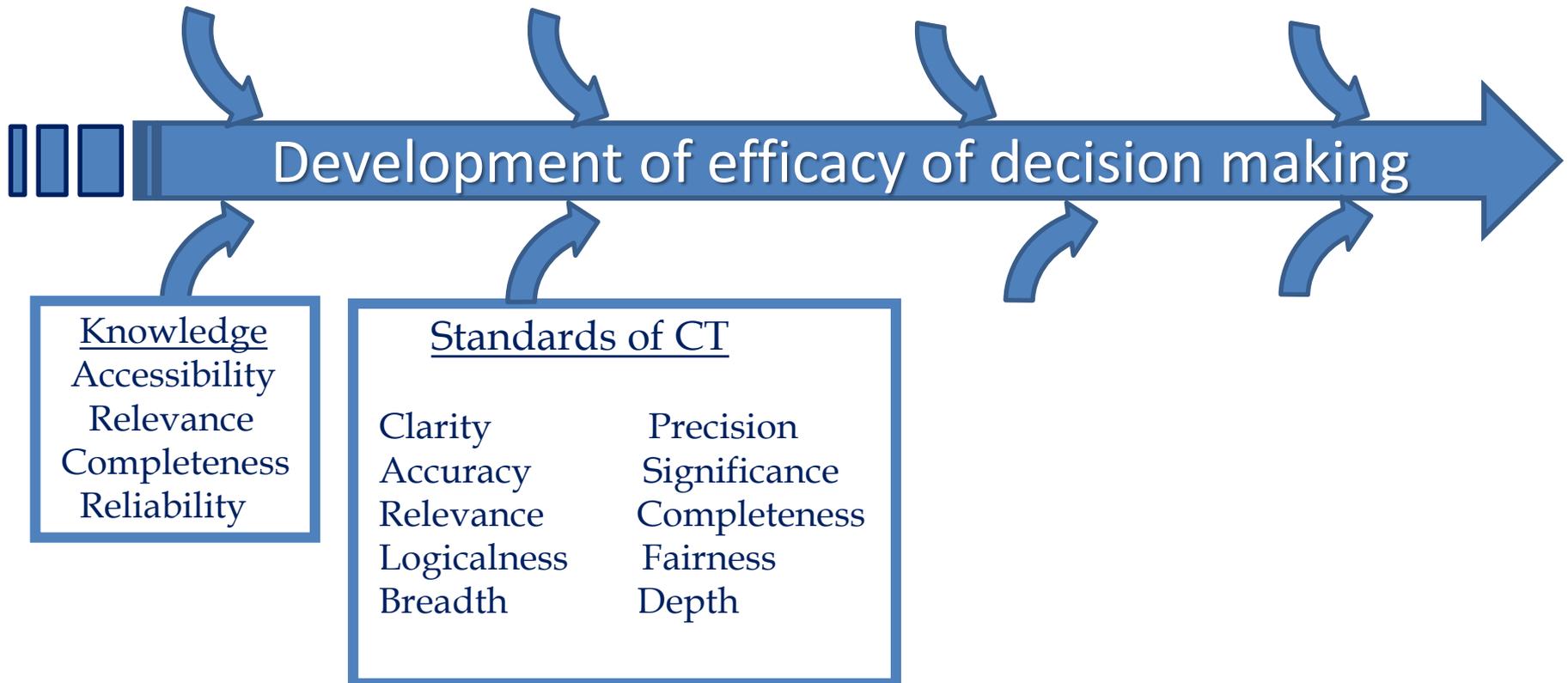
Keywords: medical decision making; medical ethics; professionalism; medical education; medical error; diagnostic error; patient safety; cognition; judgment; metacognition

No longer an option...

**Critical thinking (CT)
and clinical decision making (CDM)**



**Critical thinking (CT)
and clinical decision making (CDM)**



Critical thinking (CT) and clinical decision making (CDM)

Understanding
of CDM



Knowledge
Accessibility
Relevance
Completeness
Reliability

Standards of CT

Clarity	Precision
Accuracy	Significance
Relevance	Completeness
Logicalness	Fairness
Breadth	Depth

Critical thinking (CT) and clinical decision making (CDM)

Understanding
of CDM

Understanding
and detection of
cognitive bias

Development of efficacy of decision making

Knowledge
Accessibility
Relevance
Completeness
Reliability

Standards of CT

Clarity	Precision
Accuracy	Significance
Relevance	Completeness
Logicalness	Fairness
Breadth	Depth

Critical thinking (CT) and clinical decision making (CDM)

Understanding
of CDM

Understanding
and detection of
cognitive bias

Understanding
and detection of
logical fallacies

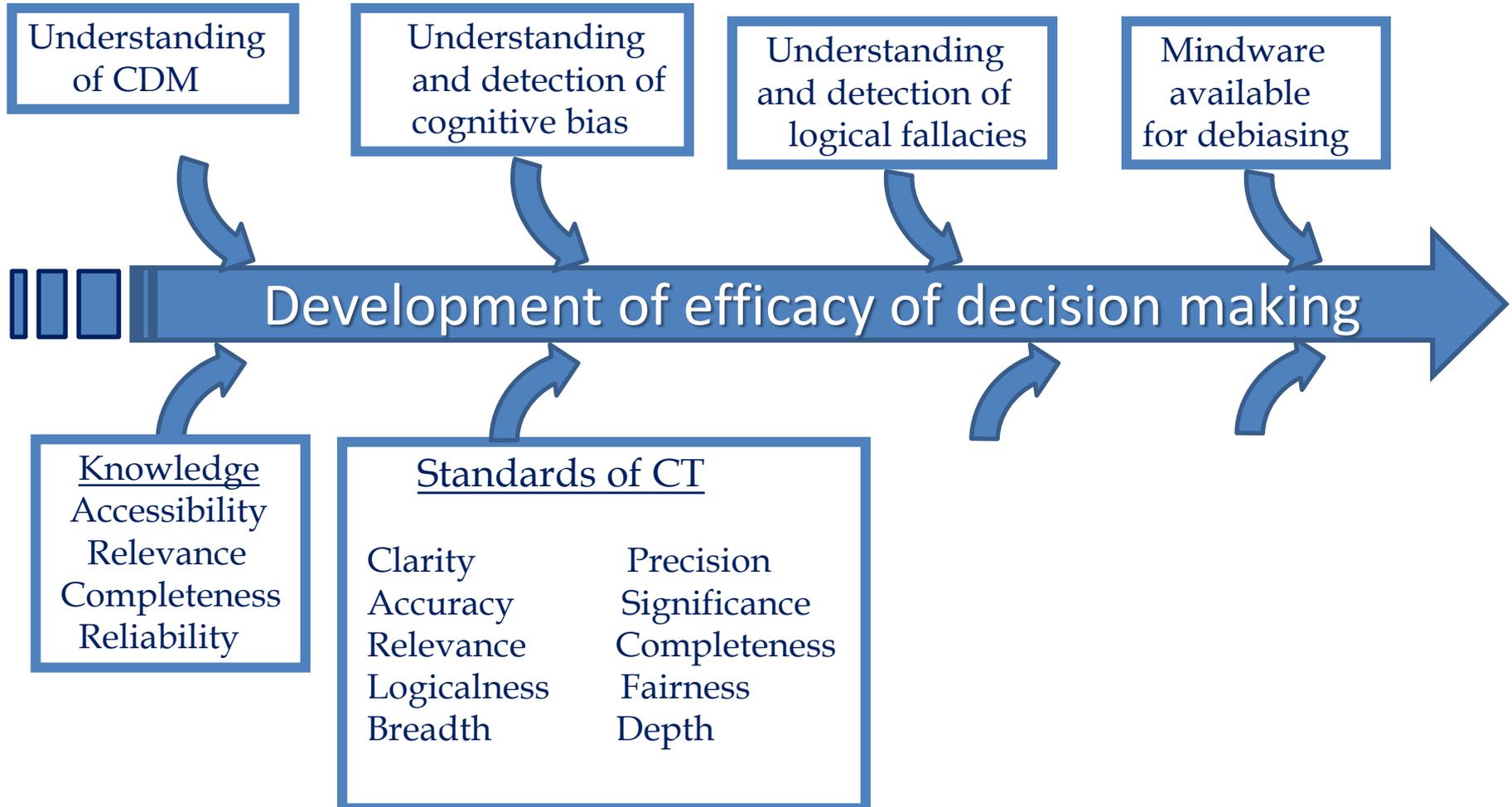
Development of efficacy of decision making

Knowledge
Accessibility
Relevance
Completeness
Reliability

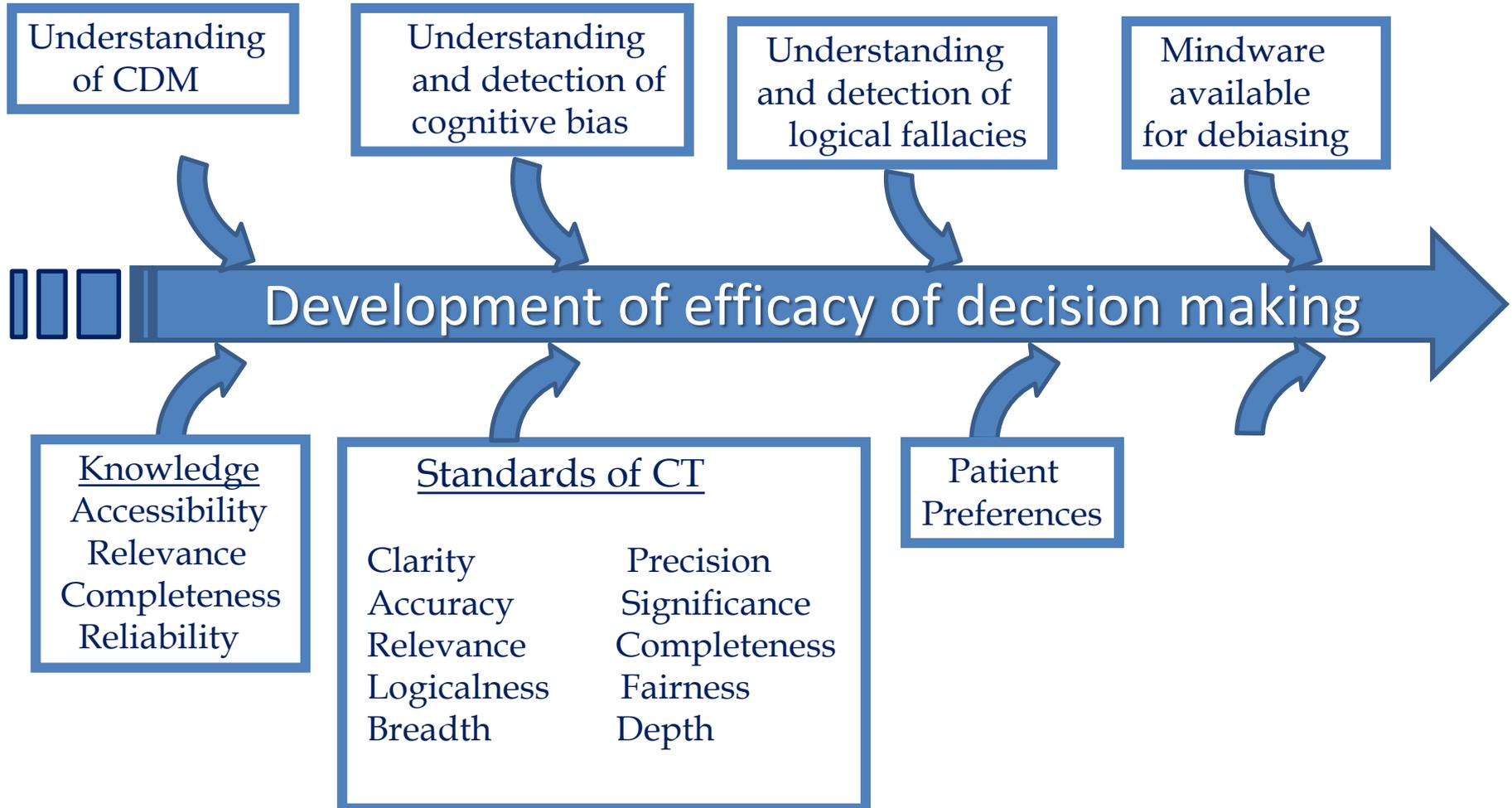
Standards of CT

Clarity	Precision
Accuracy	Significance
Relevance	Completeness
Logicalness	Fairness
Breadth	Depth

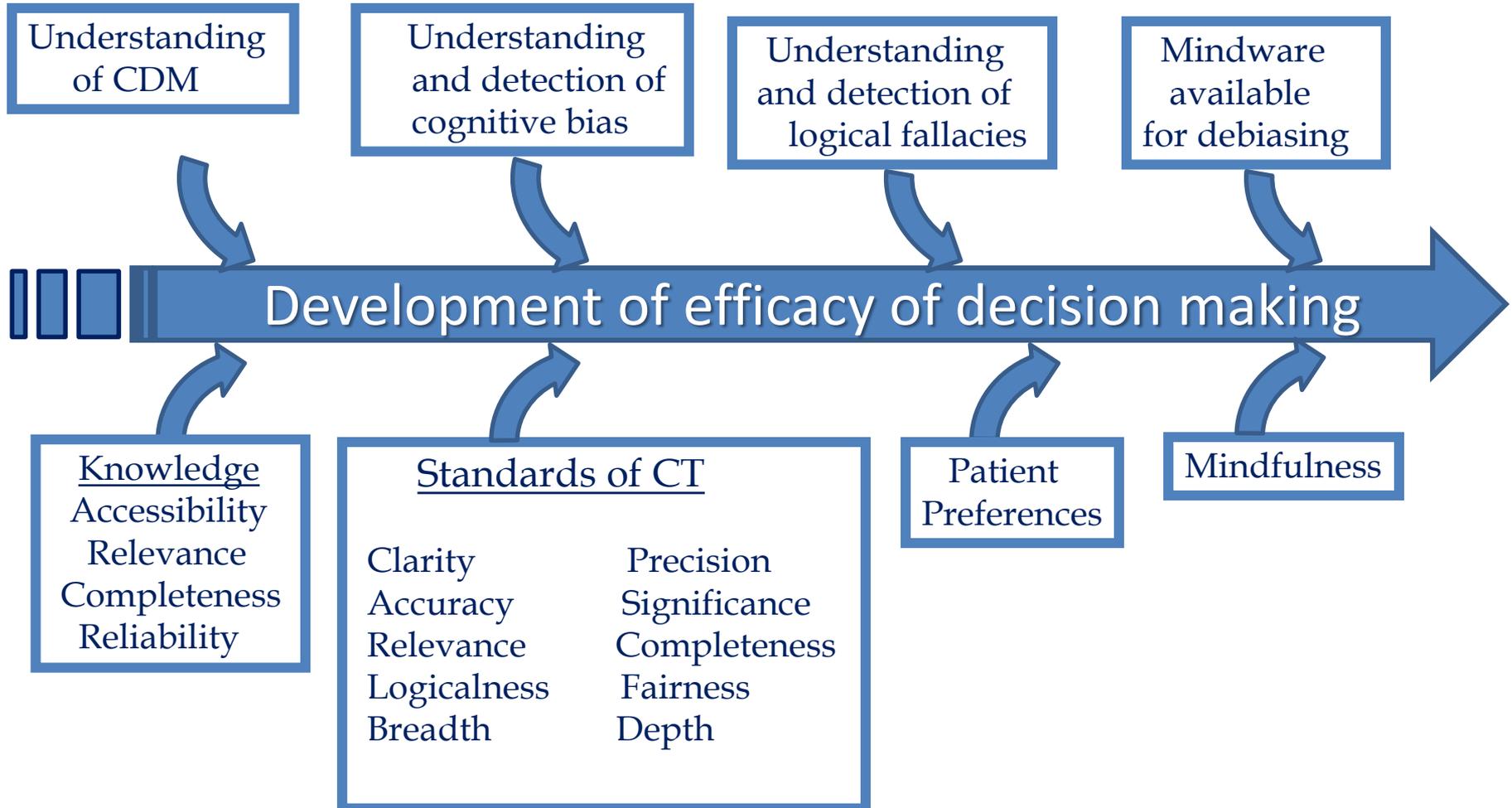
Critical thinking (CT) and clinical decision making (CDM)



Critical thinking (CT) and clinical decision making (CDM)



Critical thinking (CT) and clinical decision making (CDM)



Summary

- Critical thinking (CT) improves reasoning
- CT must be integral in clinical reasoning
- Significant gains can be made in CT by training
- It should be explicit (not implicit or tacit)
- The earlier the better for an intervention?
- Current medical training may suppress it?
- It's not too late in UGME, PGME, and CME
- It is an ethical imperative

Assessing critical thinking

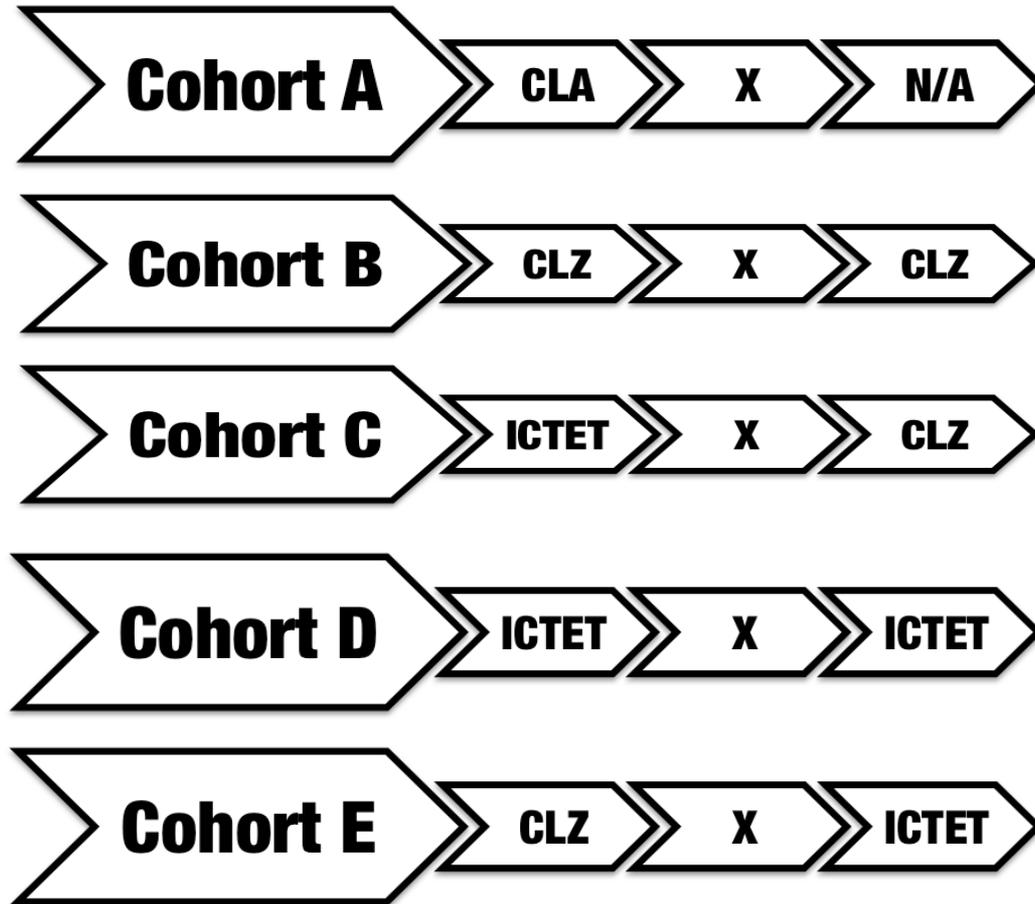
1. Can we measure development over time?
2. What are the issues in assessment?

Assessment approaches

	Inside course	Outside course
Multiple choice		Standardized tests: <ul style="list-style-type: none">• Cornell Level Z• California Test CT
Open response	Assignments scored by common rubrics	Standardized tests: <ul style="list-style-type: none">• CLA+• CAT• International CT

STUDY 1: CRITICAL THINKING IN FIRST YEAR ENGINEERING

Measure CT with standardized tests and course outcomes over a semester



CLA = Collegiate Learning Assessment

CLZ=Cornell Level Z

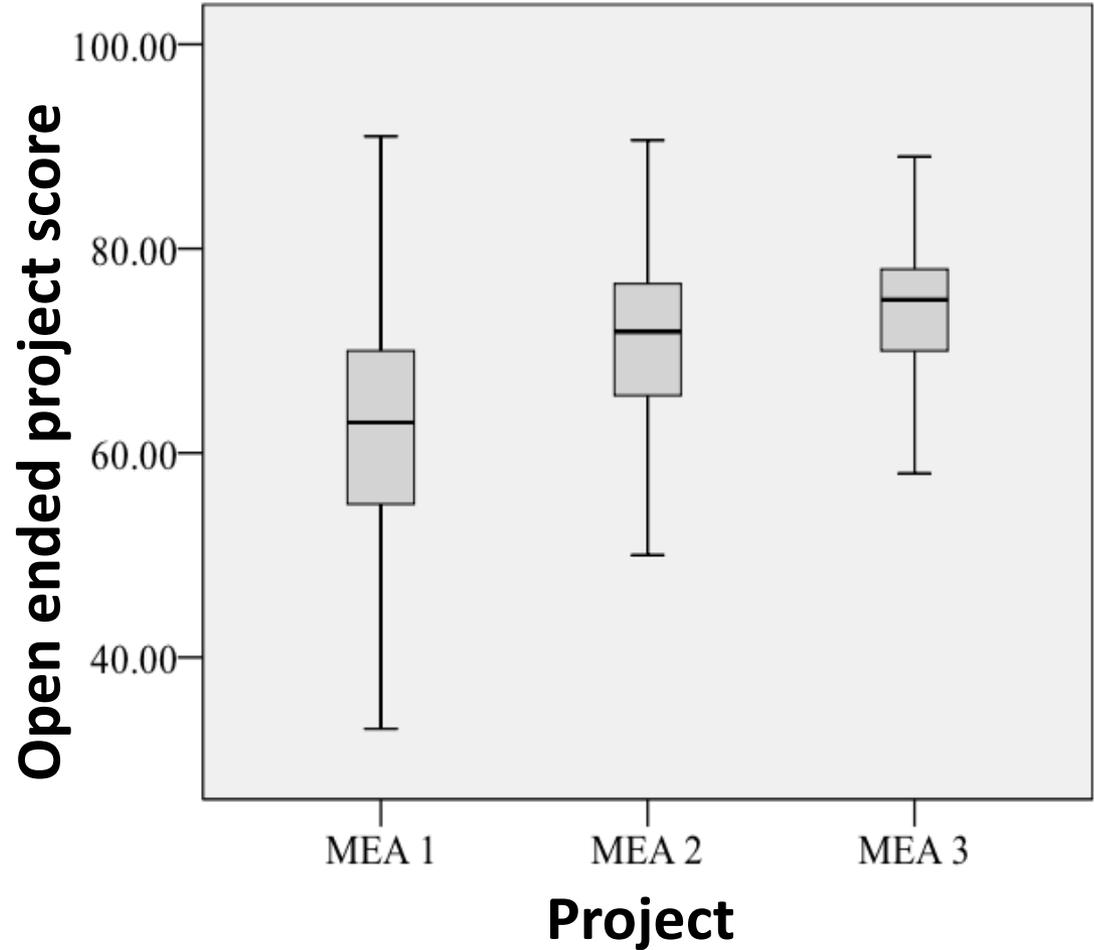
ICTET = International Critical Thinking Test

Standardized tests results:

Cornell Level Z:
No significant change

International CT:
No significant change

Course report scores:



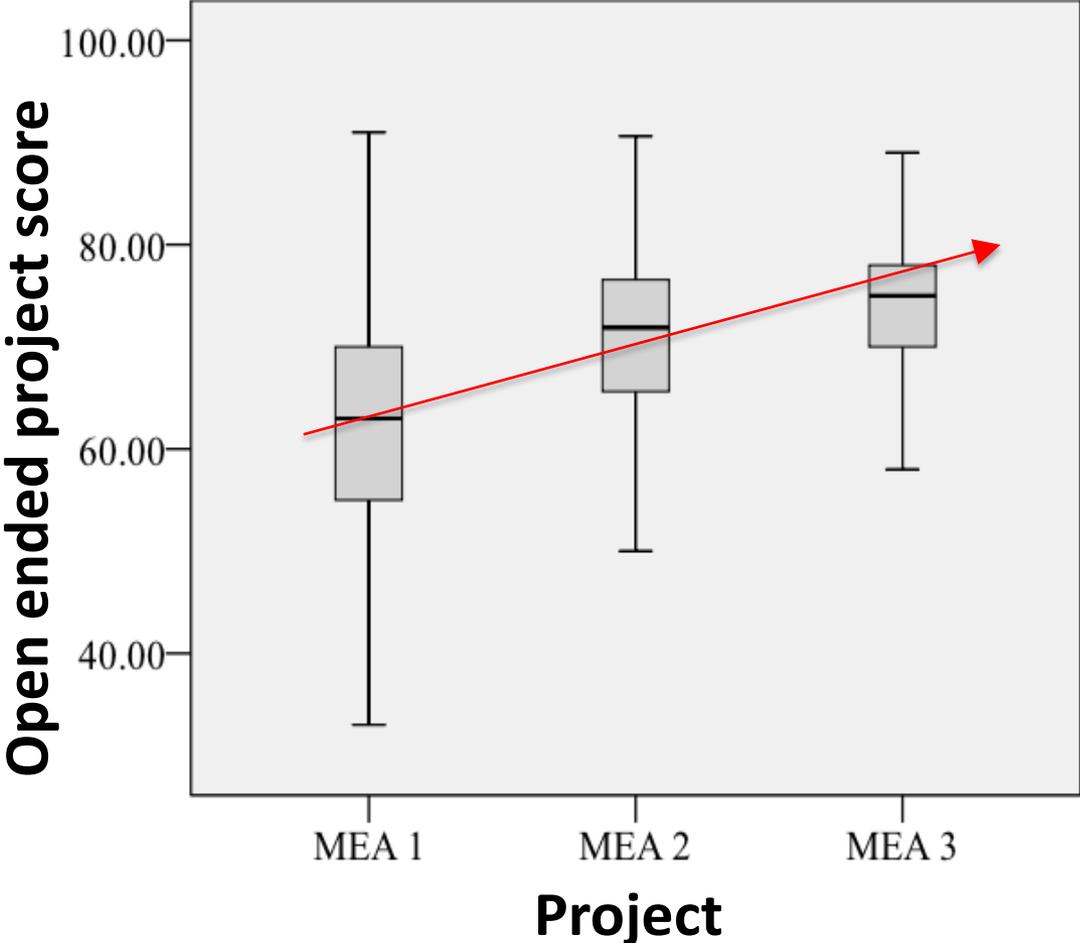
Significant development

Standardized tests results:

Cornell Level Z:
No significant change

International CT:
No significant change

Course report scores:



Significant development

**STUDY 2: LEARNING OUTCOMES
ASSESSMENT CONSORTIUM**

Assessment of Cognitive Skills

Critical thinking; Problem Solving; Written Communication; Lifelong Learning

Today

- 1 Online Test (CLA+)
- 2 Paper Test (CAT) Survey

Standardized Measurement

Meta-rubric Assessment

VALUE Rubrics

3

Coded to frameworks

Qualitative Performance Evaluation

Course Embedded Assessment

Course-based artifacts

Longitudinal study

Faculty of Arts and Science:

- Psychology
- Drama
- Physics

Faculty of Engineering and Applied Science:

- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Engineering Physics
- Geological Engineering
- Math Engineering
- Mechanical Engineering
- Mining Engineering
- Inter-disciplinary Engineering

	1 st Year	2 nd Year	3 rd Year	4 th Year
2013/14	n=1960			n=145
2014/15		n=803		
2015/16			TBA	

Assessment of Cognitive Skills

Critical thinking; Problem Solving; Written Communication; Lifelong Learning

Standardized
Measurement

Meta-rubric
Assessment

VALUE
Rubrics

Qualitative
Performance
Evaluation

Course
Embedded
Assessment

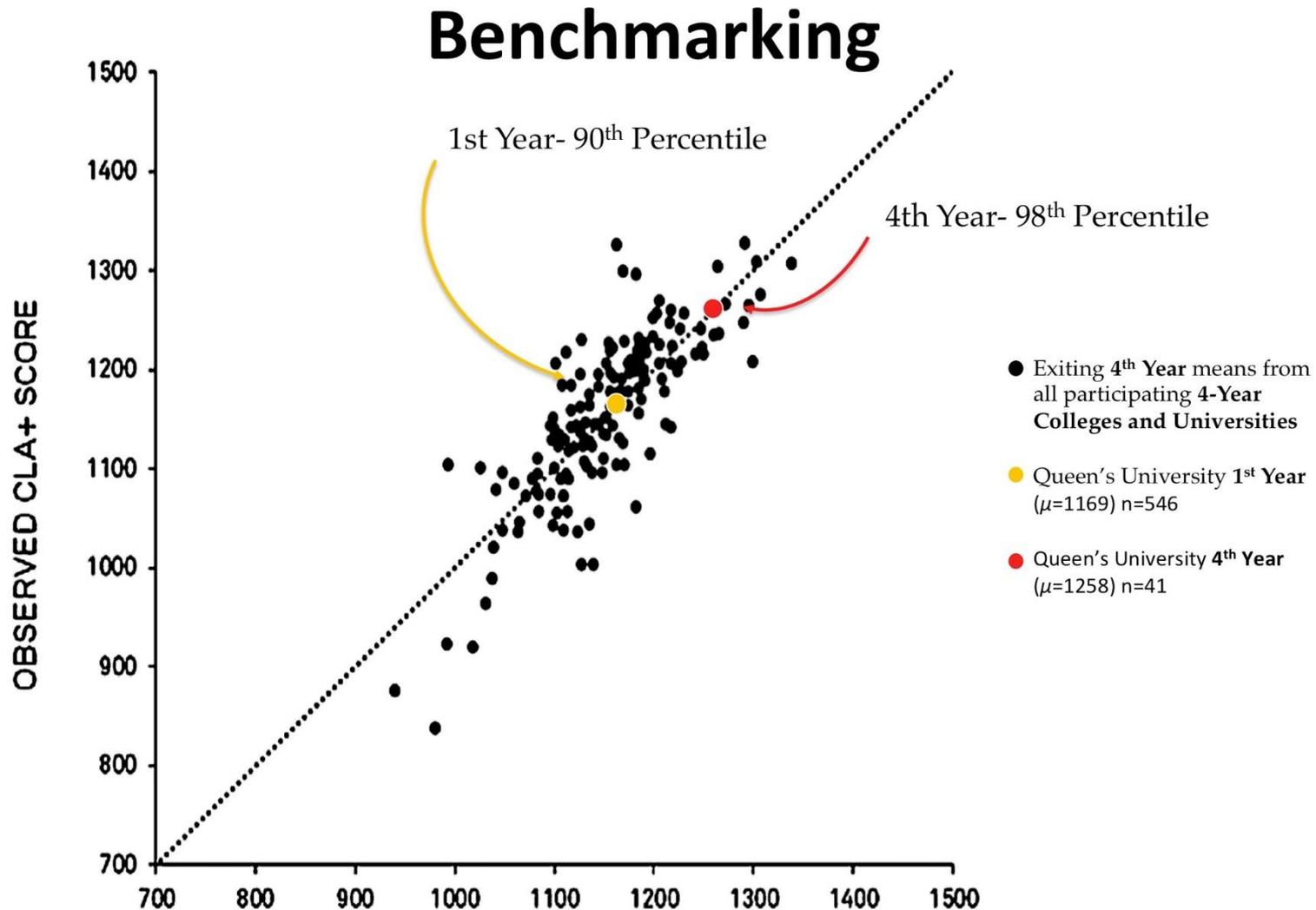
Course-
based
artifacts

Coded to
frameworks

CLA+ (critical thinking, communication)

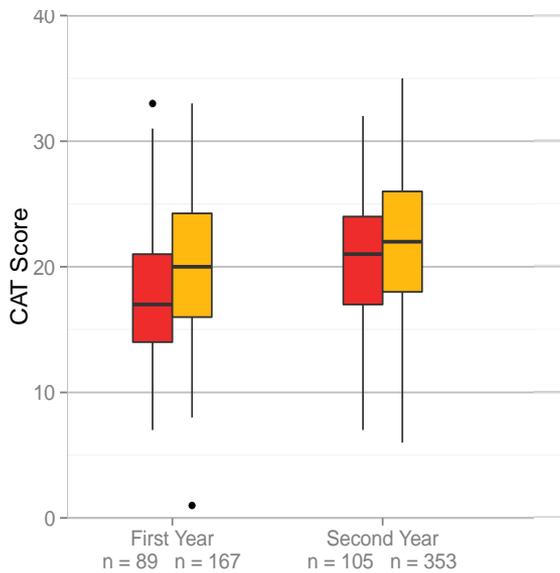
CLA+

Test

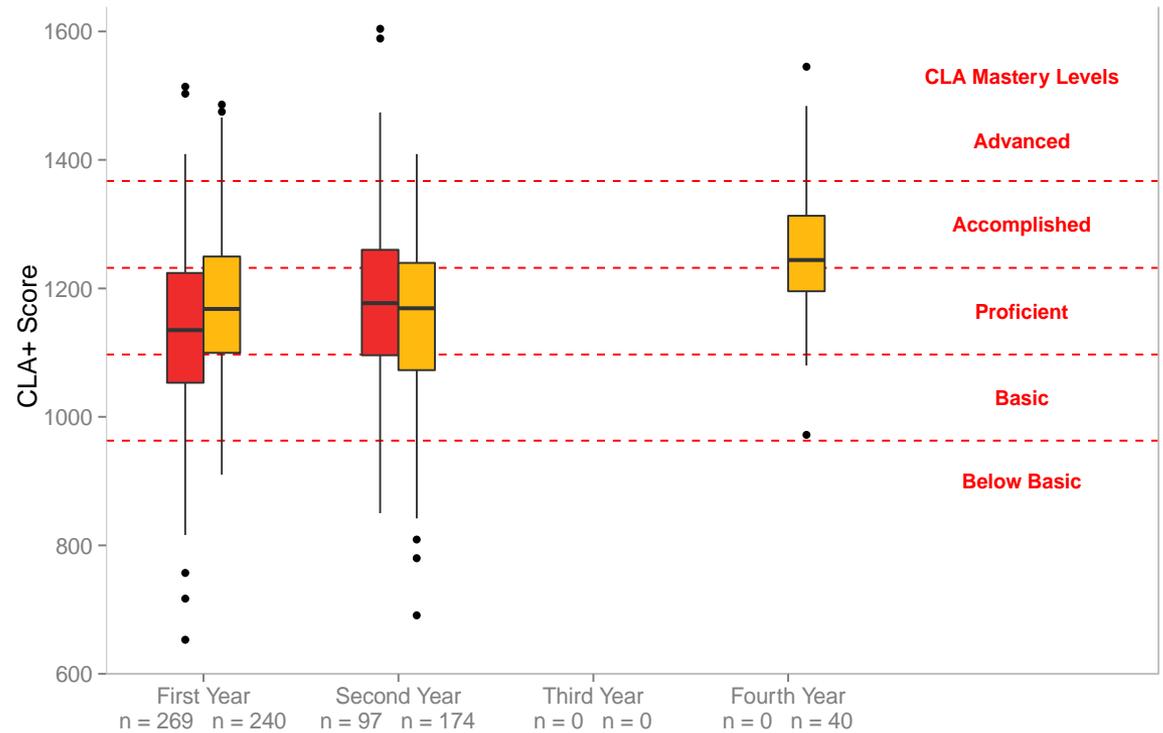


Change over 1 year

CAT



CLA+



Assessment of Cognitive Skills

Critical thinking; Problem Solving; Written Communication; Lifelong Learning

Standardized
Measurement

Meta-rubric
Assessment

VALUE
Rubrics

Qualitative
Performance
Evaluation

Course
Embedded
Assessment

Course-
based
artifacts

Coded to
frameworks

VALUE Rubric Assessment

Critical Thinking

Explains issue or problem, provides relevant information necessary for understanding

Selects and uses information to investigate a point of view

Adopts a specific position in arguments, acknowledges diverse points of view

Analyzes own and others' assumptions and evaluates the relevance of context

Evaluates consequences and implications of conclusions

Meta-rubric assessment

Scoring



breathelizer test – just above the legal limit for driving. **It is important the subjects don't come to any harm.** The group will then be given a series of pictures depicting a scene and will need to



similar in order for the test to be reliable, and if other tests exist on peers and alcohol influencing conformity, we would need them to have similar results for the test to be reliable. **In our analysis we would want to verify our experiment truly measured what we wanted it to in order for it to be valid. Once we determined that there were similar results across trials (test-retest reliability), the observers same to the same results when watching the other tapes (inter-tester reliability), the experiment tested what it was designed to test, and our results are similar to other measures testing the same thing, and the results are statistically significant, we would publish the paper for the scholarly community.**

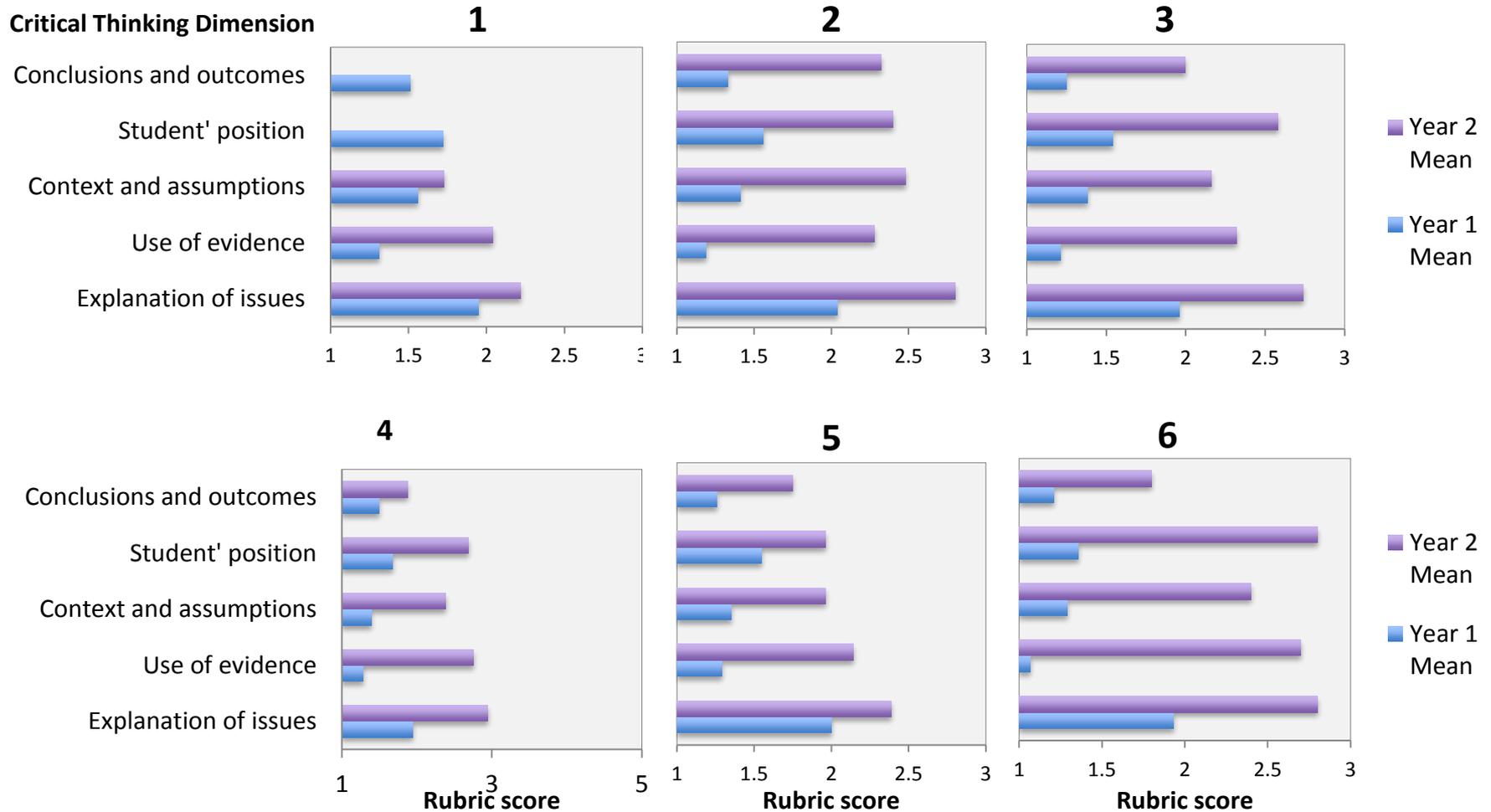
	Capstone 4	3	Missions 2	Benchmark 1
Explanation of issues	Issue/problem to be considered critically is stated clearly and described comprehensively, addressing all relevant information necessary for full understanding.	Issue/problem to be considered critically is stated, described, and clarified so that understanding is not seriously impeded by omissions.	Issue/problem to be considered critically is stated for discussion (some issues stated, analyzed, synthesized, evaluated, and/or backgrounded, addressed).	Issue/problem to be considered critically is stated without clarification or description.
Evidence <i>(taking and using information to strengthen a point of view or conclusion)</i>	Information is taken from source(s) with enough interpretation/evaluation to develop a comprehensive analysis or synthesis. Viewpoints of experts are questioned thoroughly.	Information is taken from source(s) with enough interpretation/evaluation to develop a coherent analysis or synthesis. Viewpoints of experts are subject to questioning.	Information is taken from source(s) with some interpretation/evaluation, but not enough to develop a coherent analysis or synthesis. Viewpoints of experts are taken as fact, with little questioning.	Information is taken from source(s) without any interpretation/evaluation. Viewpoints of experts are taken as fact.
Influence of context and assumptions	Thoroughly (systematically and methodically) analyzes own and others' assumptions and carefully evaluates the relevance of contexts when presenting a position.	Identifies own and others' assumptions and several relevant contexts when presenting a position.	Identifies some assumptions; identifies several relevant contexts when presenting a position. May be more aware of others' assumptions than one's own, but does so vaguely, with little questioning.	Shows an emerging awareness of process assumptions (sometimes labels assumptions as assumptions). Begins to identify some contexts when presenting a position.
Reader's position (perspective, thesis/hypothesis)	Specific position (perspective, thesis/hypothesis) is imaginative, taking into account the complexities of an issue. Limits of position are acknowledged. Other points of view are synthesized within position (perspective, thesis/hypothesis).	Specific position (perspective, thesis/hypothesis) takes into account the complexities of an issue. Other points of view are acknowledged within position (perspective, thesis/hypothesis).	Specific position (perspective, thesis/hypothesis) acknowledges different sides of an issue.	Specific position (perspective, thesis/hypothesis) is stated, but is simplistic and obvious.
Conclusions and related outcomes (implications and consequences)	Conclusions and related outcomes (consequences and implications) are logical and reflect student's informed evaluation and ability to place evidence and perspective discussed in priority order.	Conclusion is logically tied to a range of information, including opposing viewpoints, related outcomes (consequences and implications) are identified clearly.	Conclusion is logically tied to information (sources information is diverse to its extent (limited evaluation); some related outcomes (consequences and implications) are identified clearly.	Conclusion is inconsistently tied to some of the information discussed; related outcomes (consequences and implications) are oversimplified.

Not demonstrated

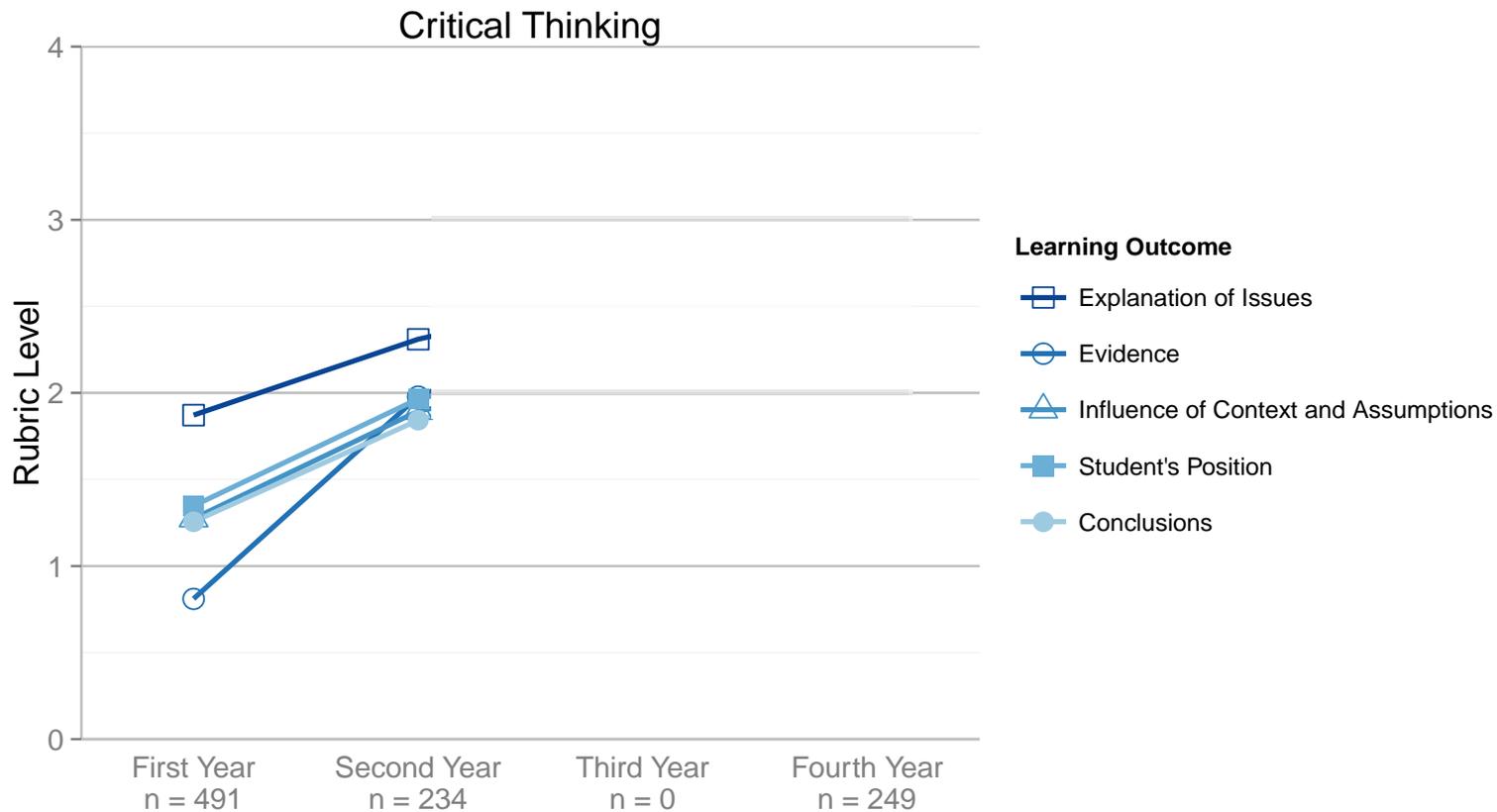
Student demonstrates awareness of the ethical impacts of a study involving alcohol, but does not discuss the ramifications.

Conclusion is tied to information presented throughout; some related and relevant implications and outcomes are identified (e.g. reliability, publishing for scholarly community).

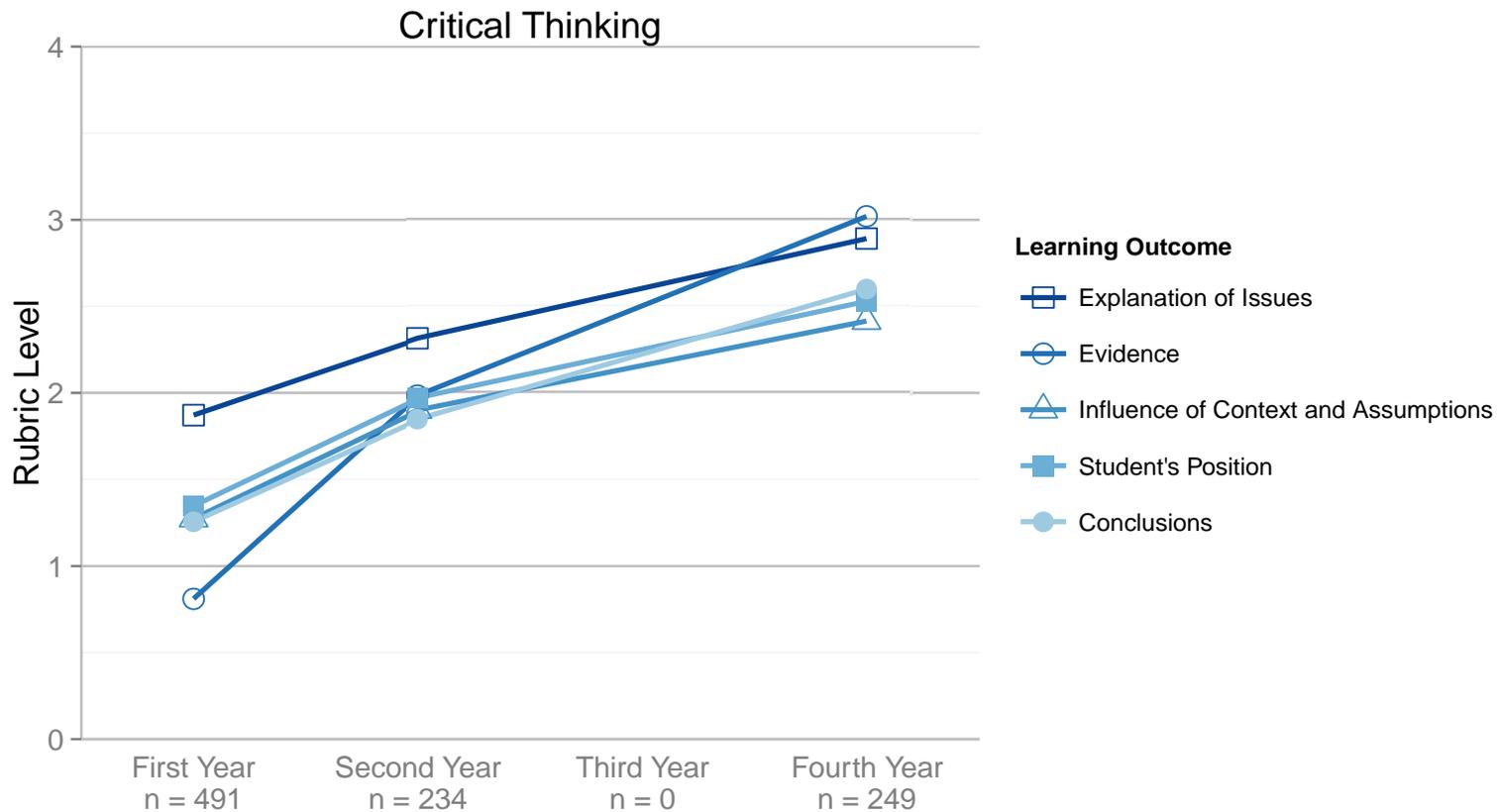
CT on reports measured by VALUE rubrics by department



Development of Critical Thinking demonstrated on course activities, scored on VALUE rubrics

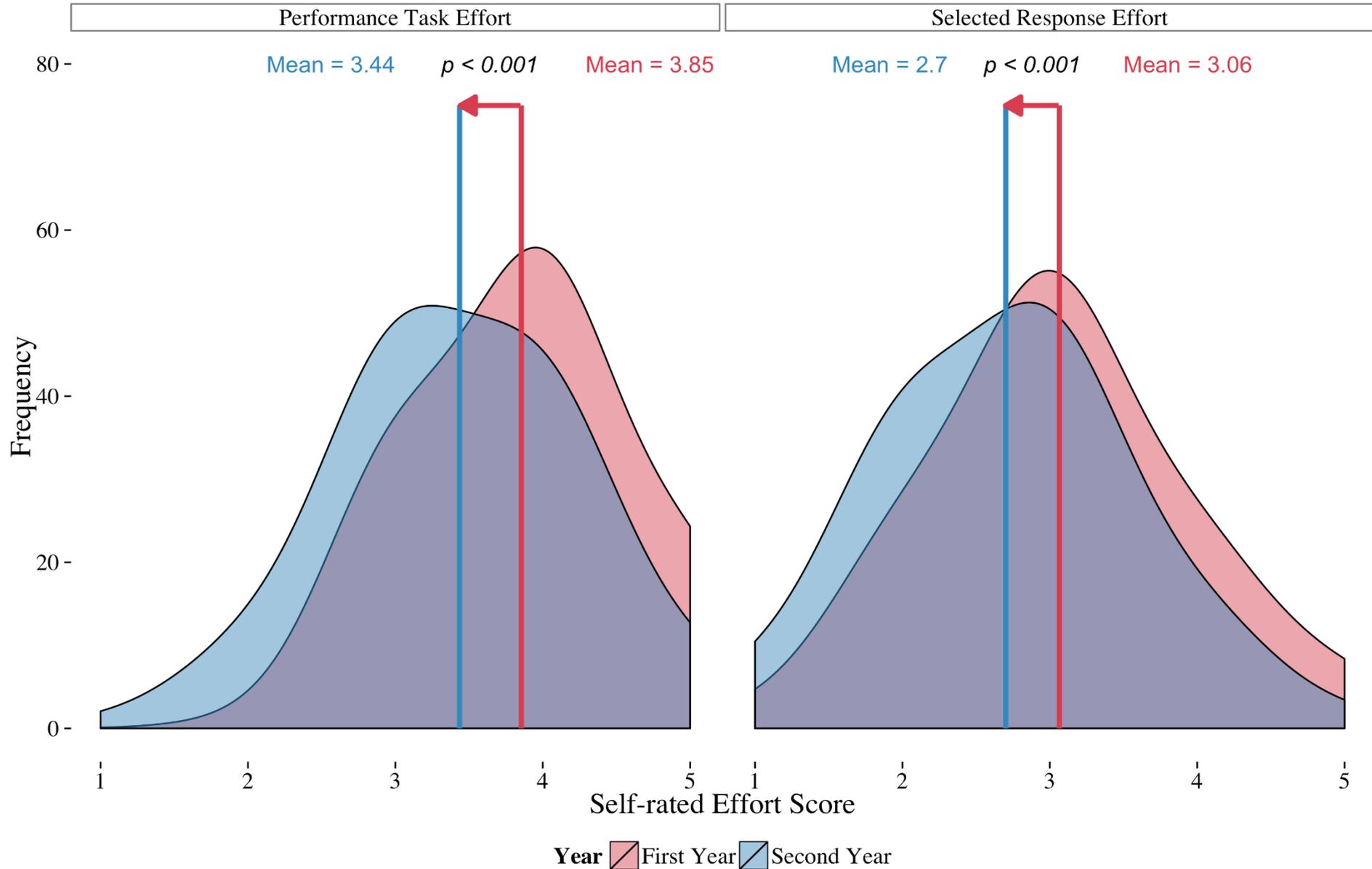


Development of Critical Thinking demonstrated on course activities, scored on VALUE rubrics

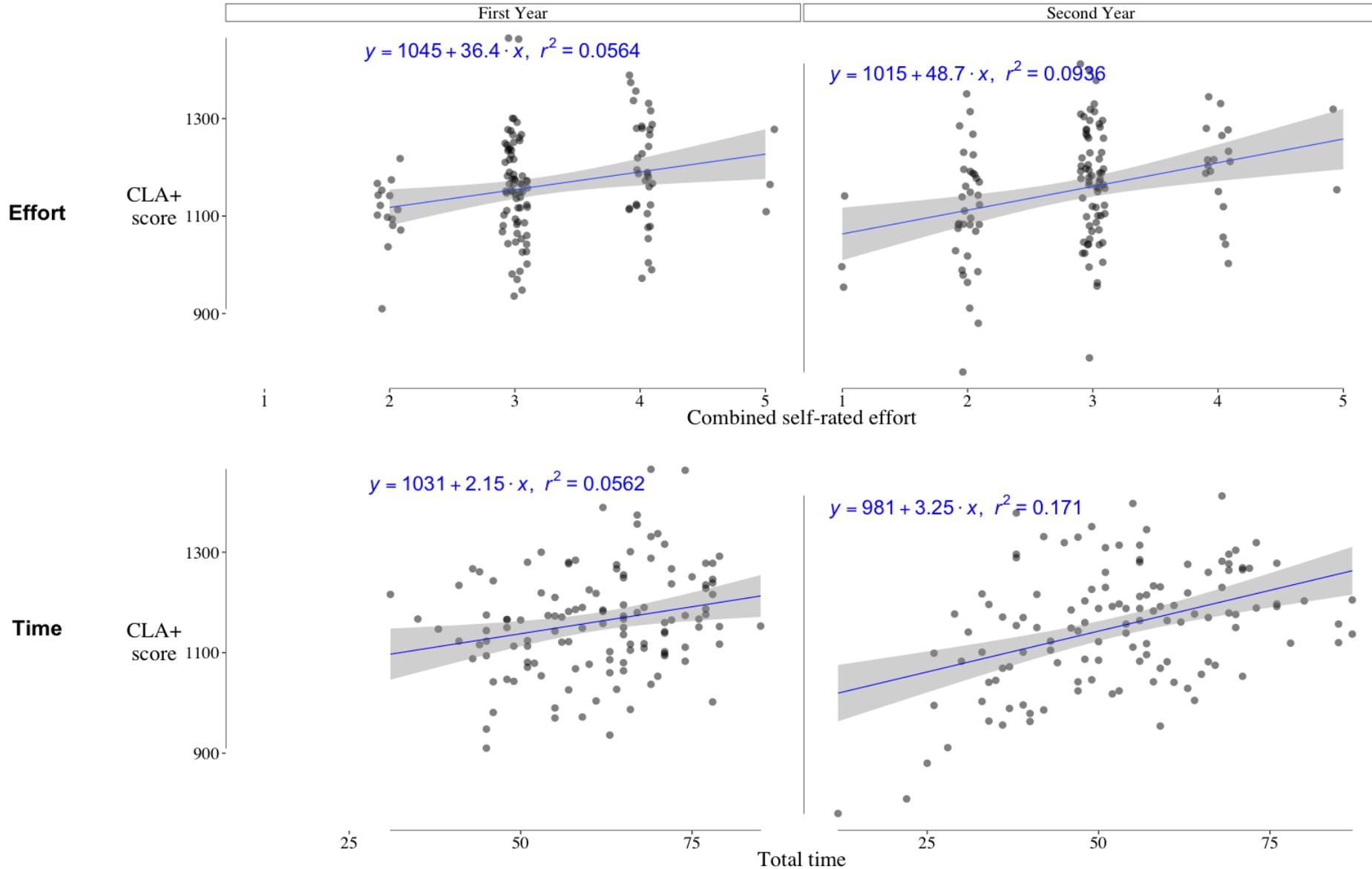


ISSUES...

Standardized tests: Effort



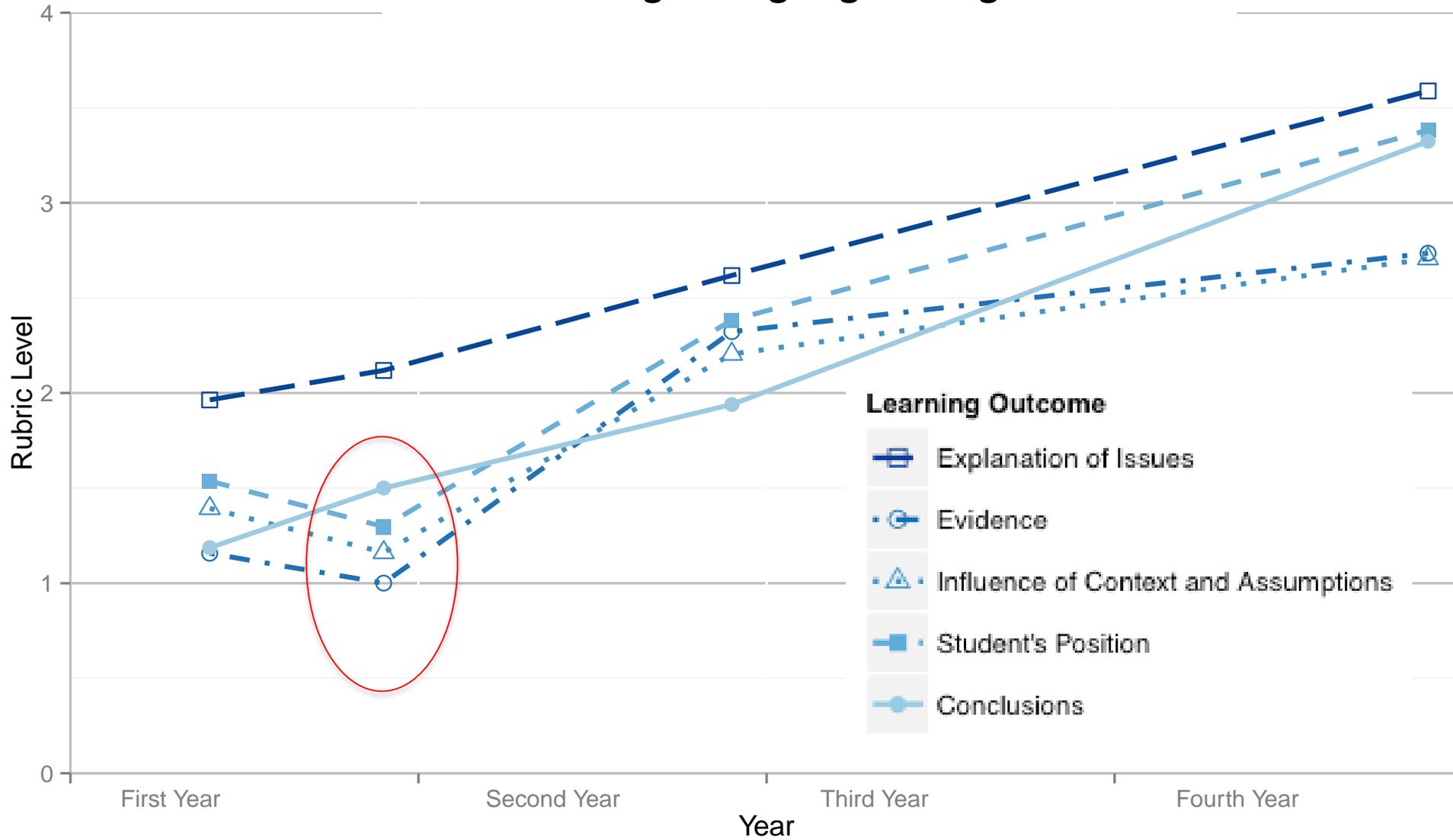
Time and self-reported effort on CLA related to performance



Comment from scorers points to alignment problem

Department ->	1	2	3
Explanation of Issues:	Reasoning was not elaborated on	Provided background and clarification	Described the social, environmental, and economic aspects
Evidence:	Were not asked to explore sources (used information provided at face value)	Used credible sources connected to the problem	Used credible sources to support their ideas
Context and Assumptions	Were not asked to explain assumptions	Described any assumptions they made to simplify the problem	Explained feasibility of implementing their prototype in the real world
Student's Position:	Not assessed	Discussed the performance and included objective information	Discussed the performance of their product and included objective information
Conclusions and Outcomes:	Not assessed	Discussed positives of design, choosing information to fit their desired conclusion	Short conclusion, did not fully address problems or issues

Critical thinking among engineering students



OUR THOUGHTS

Learning Outcomes Project

Building Assessment Scaffolds for Intellectual Skills

Start Here

Feedback

View List

Search

Step 1

Step 2

Step 3

Step 4

Step 5

What is it that the students are going to be doing? (Please select one)

- Researching, planning, producing and reflecting (**Creative Thinking**)
- Designing, implementing and evaluating (**Problem Solving**)
- Investigating, transferring understanding and reflecting (**Critical Thinking**)

Continue

Learning Outcomes Project

Building Assessment Scaffolds for Intellectual Skills

[Start Here](#)

[Feedback](#)

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Step 1

Step 2

Step 3

Step 4

Step 5

Complete the following statement

This assignment is about... (E.g. creative writing; bridge failure; light waves; political campaigning)

research design

Continue

Learning Outcomes Project

Building Assessment Scaffolds for Intellectual Skills

[Start Here](#)

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Step 1

Step 2

Step 3

Step 4

Step 5

What dimensions do you want to assess? (click all that apply)

- Define problem
- Strategies
- Solution / hypothesis
- Evaluation
- Implementation
- Outcomes / implications

Note: the rubric criteria are describing intellectual skills, content areas that you might want to assess need to be added

[Continue](#)

Learning Project

Building Assessment

Step 1

What dimension

- Define problem
- Strategies
- Solution / hypothesis
- Evaluation
- Implementation
- Outcomes / impl

Note: the rubric criteria

Continue

Step 1

Step 2

Step 3

Step 4

Step 5

What aspects of these components are relevant to your task?

What aspects of the assessment dimensions do you want to assess? (select all that apply)

Define problem	Problem	Purpose			
Strategies	Strategies	Approaches	Procedures		
Solution / hypothesis	Design	Product	Solution	Structures	Hypothesis
Evaluation	Impacts	Contexts	Logical arguments	Feasibility issues	Confounds / sources of error

Submit

Learning Project

Building Assessment

Step 1 > Step 2

What dimension

- Define problem
- Strategies
- Solution / hypothesis
- Evaluation
- Implementation
- Outcomes / implications

Note: the rubric criteria

Continue

Step 1 > Step 2 > Step 3 > Step 4 > Step 5

Assignment: "research design"

[Edit Content](#)

Problem Solving	1	2	3	4
Define problem	Describes the <i>purpose</i> as related to <i>research design</i>	Explains the <i>purpose</i> as related to <i>research design</i>	Analyzes <i>purpose</i> , contextually appropriate to <i>research design</i>	Evaluates the contextually diverse nature of the <i>purpose</i> applied to <i>research design</i>
Strategies	Lists <i>strategies and procedures</i> that might be used for solving the problem	Uses a single <i>strategies and procedures</i> appropriate to finding a solution	Incorporates multiple <i>strategies and procedures</i> to find a solution	Adapts <i>strategies and procedures</i> to allow for complexities when finding a solution
Solution / hypothesis	Presents simplistic <i>design and hypothesis</i> that partially address the problem	Presents satisfactory <i>design and hypothesis</i> addressing the problem	Presents coherent <i>design and hypothesis</i> tailored to the problem	Presents elegant <i>design and hypothesis</i> comprehensively addressing the problem
Evaluation	Identifies some <i>contexts, feasibility issues, and confounds / sources of error</i> that relate to the problem	Explains <i>contexts, feasibility issues, and confounds / sources of error</i> when addressing the problem	Assesses <i>contexts, feasibility issues, and confounds / sources of error</i> when solving the problem	Evaluates <i>contexts, feasibility issues, and confounds / sources of error</i> when solving the problem

Finalize

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Learning Project

Building Assessment

Step 1

What dimension

- Define problem
- Strategies
- Solution / hypothesis
- Evaluation
- Implementation
- Outcomes / impl

Note: the rubric criteria

Continue

Step 1

Step 2

Assignment: "research

Edit Content

Problem Solving

Define problem

Strategies

Solution / hypothesis

Evaluation

Finalize

Learning Outcomes Project

Building Assessment Scaffolds for Intellectual Skills

Start Here

Feedback

View List

Search

Step 1

Step 2

Step 3

Step 4

Step 5

Complete!

Your rubric has been saved! Download your rubric in [CSV](#) format.

Assignment: "research design"

	1	2	3	4
Problem Solving				
Define problem	Describes the <i>Purpose</i> as related to <i>research design</i>	Explains the <i>Purpose</i> as related to <i>research design</i>	Analyzes <i>Purpose</i> , contextually appropriate to <i>research design</i>	Evaluates the contextually diverse nature of the <i>Purpose</i> applied to <i>research design</i>
Strategies	Lists <i>Strategies, Procedures</i> that might be used for solving the problem	Uses a single <i>Strategies, Procedures</i> appropriate to finding a solution	Incorporates multiple <i>Strategies, Procedures</i> to find a solution	Adapts <i>Strategies, Procedures</i> to allow for complexities when finding a solution
Solution / hypothesis	Presents simplistic <i>Design, Hypothesis</i> that partially address the problem	Presents satisfactory <i>Design, Hypothesis</i> addressing the problem	Presents coherent <i>Design, Hypothesis</i> tailored to the problem	Presents elegant <i>Design, Hypothesis</i> comprehensively addressing the problem
Evaluation	Identifies some <i>Contexts, Feasibility issues, Confounds / sources of error</i> that relate to the problem	Explains <i>Contexts, Feasibility issues, Confounds / sources of error</i> when addressing the problem	Assesses <i>Contexts, Feasibility issues, Confounds / sources of error</i> when solving the problem	Evaluates <i>Contexts, Feasibility issues, Confounds / sources of error</i> when solving the problem

Learning Project

Building Assessment

Step 1

What dimension

- Define problem
- Strategies
- Solution / hypothesis
- Evaluation
- Implementation
- Outcomes / impl

Note: the rubric criteria

Continue

Step 1

Step 2

Assignment: "research

Edit Content

Problem Solving

Define problem

Strategies

Solution / hypothesis

Evaluation

Finalize

Learning Outcomes Project

Rubrics generated are listed here

Building Assessment Scaffolds for Intellectual Skills

Start Here

Feedback

View List

Search

Pilot project feedback here

Rubrics are searchable

Step 1

Step 2

Step 3

Step 4

Step 5

Complete!

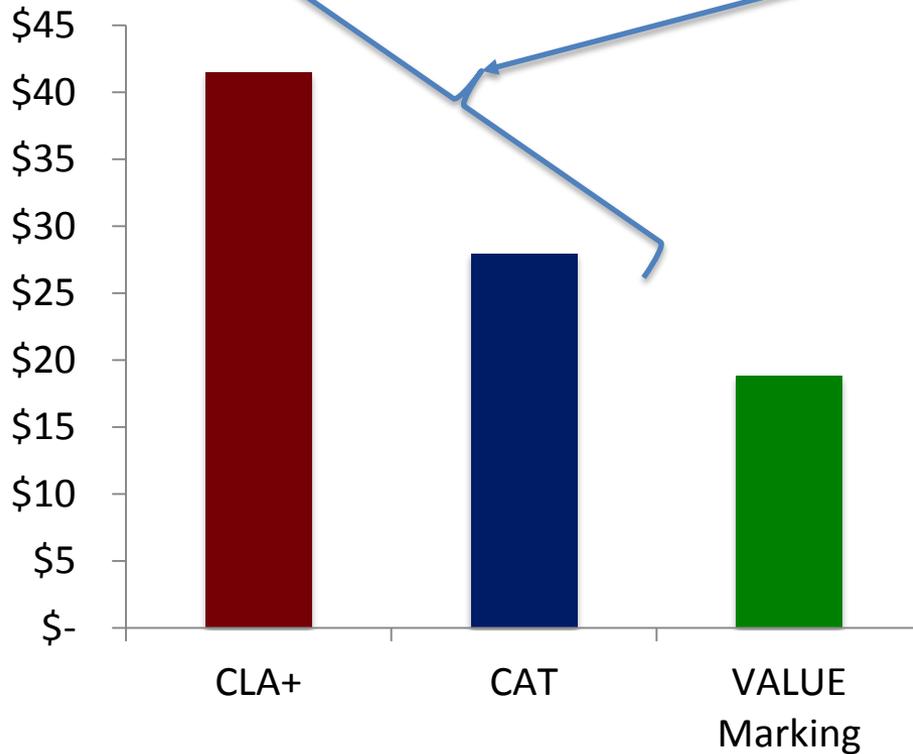
Your rubric has been saved! Download your rubric in [CSV](#) format.

Assignment: "research design"

	1	2	3	4
Problem Solving				
Define problem	Describes the <i>Purpose</i> as related to <i>research design</i>	Explains the <i>Purpose</i> as related to <i>research design</i>	Analyzes <i>Purpose</i> , contextually appropriate to <i>research design</i>	Evaluates the contextually diverse nature of the <i>Purpose</i> applied to <i>research design</i>
Strategies	Lists <i>Strategies, Procedures</i> that might be used for solving the problem	Uses a single <i>Strategies, Procedures</i> appropriate to finding a solution	Incorporates multiple <i>Strategies, Procedures</i> to find a solution	Adapts <i>Strategies, Procedures</i> to allow for complexities when finding a solution
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Evaluation	Identifies some <i>Contexts, Feasibility issues, Confounds / sources of error</i> that relate to the problem	Explains <i>Contexts, Feasibility issues, Confounds / sources of error</i> when addressing the problem	Assesses <i>Contexts, Feasibility issues, Confounds / sources of error</i> when solving the problem	Evaluates <i>Contexts, Feasibility issues, Confounds / sources of error</i> when solving the problem

Cost and effort of assessing

Cost per Completed Consenting Sample



Standardized testing is more time consuming and expensive

Evaluating coursework with generic rubrics becomes more difficult in upper-year courses, as content expertise is required

Measuring CT

Standardized tests

- Allow for external comparison, “turnkey”
- Often have motivational problems or self-response bias
- Small gains (over 1 year) can be hidden

Embedded assessment

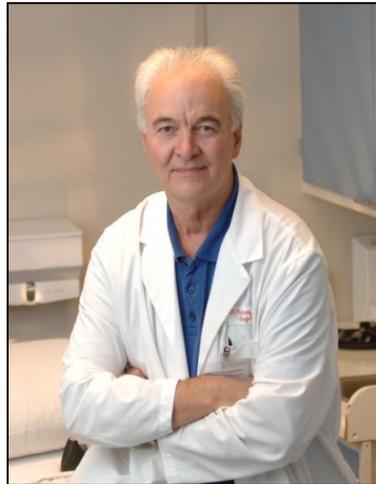
- Often causes instructors to think about CT in courses
- Alignment issues: course assignments may not explicitly require CT

Today's experts



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The screenshot shows the homepage of the Higher Education Quality Council of Ontario (HEQCO). At the top left is the HEQCO logo and name, with the tagline "An agency of the Government of Ontario". To the right are navigation links: Home, Newsroom, Contact Us, Sitemap, and Français. Below this is a search bar and a secondary navigation menu with links for Postsecondary Issues, Research, It's Not Academic Blog, and About Us. The main content area features a large graphic with three horizontal bars (green, blue, red) and the text "CANADIAN POSTSECONDARY PERFORMANCE IMPACT 2015" and "Money matters but outcomes matter more". Below this is a quote: "When this circuit learns your job, what are you going to do?" - Marshall McLuhan. The page is divided into three columns: "FOLLOW US ON TWITTER" showing recent tweets from @HEQCO; "ITSNOTACADEMIC BLOG" with two recent blog posts; and "LATEST RESEARCH PUBLICATIONS" listing several reports. At the bottom, there are four sections: "Quick Links" (News Releases, Research Publications, Requests for Proposals, Quick Stats), "Social Networking" (Twitter, Facebook, YouTube, RSS), "Contact Us" (address, phone, fax, email), and "Join Our Mailing List" (Name, Email, and a "Keep me informed" button). A footer contains "Privacy Policy" and "© Queen's Printer for Ontario 2015".

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