

Teaching Note – Indoor Air Cartoon Journal



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TEACHING NOTE: THE INDOOR AIR CARTOON JOURNAL THINKING-TRACE APPROACH

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Purpose of Indoor Air Cartoon Journal Fictional Case Stories

The fictional case stories published in the Indoor Air Cartoon Journal (IACJ) are communication solutions designed primarily to invite learners into an iterative process for developing a transferable way of thinking that strengthens cognitive governance and lifelong-learning capability, thereby providing upstream readiness for value-oriented problem diagnosis and solving.

Many learners and educators associate case-based education with the Harvard-style case method. Harvard-style cases are generally grounded in real-world organisations, people and events. Learners primarily analyse the problem presented, form judgements, decide what should be done and propose appropriate actions. The ways of thinking and decision-making capabilities developed through repeated engagement with such cases may also inform how learners approach future problems.

IACJ cases have a different primary purpose. They are intentionally designed as fictional case story communication solutions, while the knowledge embedded within them is factual and grounded in established scientific evidence. Learners are not primarily expected to solve the problem presented in an IACJ case, make an immediate decision about it or recommend what its protagonists should do. Instead, the fictional problem provides a context for mental stimulation through which learners can encounter, connect, contextualise and reason with established knowledge.

Through this engagement, learners can develop and refine mental models, generate value-oriented questions, exercise relevant cognitive capabilities and become more conscious of how they form judgements, make decisions and determine actions. These processes support the iterative development and refinement of a transferable way of thinking that strengthens cognitive governance and lifelong-learning capability, thereby providing upstream readiness for value-oriented problem diagnosis and solving.

The development and refinement of this way of thinking begin during engagement with the story and continue iteratively. Its primary application occurs later, when the learner

encounters a future real-life problem that may or may not resemble the problem presented in the case. The transferable way of thinking can then inform judgements, decisions and actions appropriate to the evidence, people, purposes, constraints and circumstances of that real-life situation.

Fundamental Pedagogical Position

The primary question underlying a decision-centred case is commonly: *What judgement or decision should be made about the problem presented in this case?* The primary question underlying an IACJ fictional case story is different: *What iterative, transferable way of thinking can I develop through this story and later use to inform my judgement, decisions and actions when I encounter future real-life problems?*

Intended Learning Journey

Engagement with an IACJ fictional case story is intended to stimulate an iterative relationship among mental model development and refinement, value-oriented questioning, critical and reflective thinking, abstract reasoning, logical deduction, creative imagination, the connection and contextualisation of established knowledge, awareness of assumptions, relationships, interactions and consequences, cognitive governance, judgement and decision-making, and value-oriented action.

These are not fixed, consecutive stages. A question may alter a mental model, while a refined mental model may generate a different question. Critical thinking may interrogate assumptions and evidence; abstract reasoning may reveal principles and patterns extending beyond the particular story; logical deduction may expose relationships, implications and consequences; creative imagination may generate alternative explanations, possibilities and applications; and reflective thinking may enable learners to reconsider and refine their earlier interpretations. Through repeated engagement, these cognitive abilities interact to help learners abstract and progressively refine a transferable way of thinking from the particular story. That way of thinking can subsequently be adapted to different problems, people, places, disciplines and circumstances.

By enabling these cognitive abilities to interact in the development and refinement of a transferable way of thinking, IACJ strengthens learners' cognitive governance and lifelong-learning capability, thereby providing upstream readiness for value-oriented problem diagnosis and solving in scientific research, applied research, professional practice, education and everyday life. This lifelong-learning capability enables learners to continuously process information generated through future exposures into experience, comprising knowledge, understanding and skills, that can provide value to themselves or others.

Who Can Use IACJ Cases?

IACJ fictional case stories can be used by school, undergraduate, postgraduate and continuing education learners; educators across disciplines; researchers and professional practitioners; members of industry and professional bodies; and members of the public engaged in self-directed learning. Although the stories are contextualised principally within indoor air quality and sustainable building engineering, they are generally written in accessible language so that readers without specialist expertise in these areas, including professionals from other built-environment disciplines, can comprehend and relate to them.

The transferable way of thinking developed through the stories may consequently be relevant to future problems within or beyond the fields in which the stories are situated. As IACJ is freely and publicly accessible, intended users can engage with its cases directly. An educator may facilitate and deepen the engagement, but an intermediary adopter or delivery agent is not required.

Guidance for Educators

Educators should introduce an IACJ case using the following framing: Engage with this story not primarily to solve its presented problem, but to notice what it stimulates you to think about and to develop a way of thinking that you can carry into future real-life situations. Educators should avoid converting the story into a conventional problem requiring an immediate solution, an exercise requiring learners to decide what the protagonist should do, a search for one correct interpretation, a test of whether learners can reproduce the story's technical content, or a basis for claiming that one activity has measured improvement in cognitive governance.

Instead, educators should provide space for learners to notice what the story stimulates in them, encourage them to generate and pursue their own questions, support the development and refinement of their mental models, and help them distinguish the underlying way of thinking from the specific circumstances of the story.

Educators should also encourage transfer to future situations that may look different from the case, welcome different defensible interpretations, preserve uncertainty where the available information does not support a judgement, encourage learners to revisit and refine their thinking over time, and provide feedback on the quality of learners' expressed reasoning and reflection rather than their agreement with the educator.

The reflective questions below constitute a flexible question bank, not a compulsory questionnaire or fixed sequence. Educators should select only those questions that are appropriate for the learners, context, and intended depth of engagement.

Primary Reflective Question

What iterative, transferable way of thinking does this fictional case story invite you to develop, and how could that way of thinking later inform your judgement, decisions and

actions when you encounter future real-life problems that may or may not resemble the problem presented in the story?

Reflective Question Bank:

Mental Stimulation

1. What did the story cause you to notice, question, reconsider or become curious about?
2. Which aspect of the story produced the strongest mental or emotional engagement for you, and what did it bring into your thinking?
3. What uncertainty, tension, contradiction or unresolved issue remained in your mind after engaging with the story?
4. Did the story challenge anything that you had previously taken for granted? If so, what was challenged?

Mental Model Development

5. What outcome appears to matter within the situation presented, and what factors could contribute to that outcome?
6. What relationships and interactions among those factors became visible to you?
7. How did your mental model of the situation develop or change as you continued engaging with the story?
8. What assumptions made by the characters, or present in your own initial thinking, became visible?
9. What important factor, relationship or perspective might still be absent from your mental model?

Questioning and Reasoning

10. What value-oriented questions did the story stimulate you to generate?
11. How did those questions interrogate, challenge, extend or refine your mental model?
12. How did you connect, contextualise or reconsider established knowledge while engaging with the story?
13. What forms of thinking did the story invite you to exercise, and how did they interact?
14. What additional information would be needed before a sound judgement could be made in a corresponding real-life situation?
15. What did the story teach you about the danger of forming a judgement, making a decision or taking action before developing an adequate mental model?

Developing a Transferable Way of Thinking

16. What underlying principle, relationship, pattern or way of reasoning can you abstract from the story?

17. Can you explain this way of thinking without merely retelling the story or reproducing its apparent solution?
18. What makes this way of thinking transferable beyond the particular problem presented?
19. What aspects of it would need to be adapted when the people, purpose, evidence, constraints or context change?
20. What are the limitations of this way of thinking? Under what circumstances might it be inappropriate or insufficient?

Transfer to Future Real-Life Problems

21. What future real-life situation resembling the case might benefit from this way of thinking?
22. What apparently unrelated future problem might also benefit from it?
23. What underlying similarity would allow the way of thinking to transfer between these different situations?
24. What might this way of thinking help you notice before forming a judgement about a future problem?
25. What questions might it help you ask before making a future decision or taking action?
26. How might it help you diagnose an underlying problem rather than react only to its visible symptoms?
27. How might it help you consider usefulness, human consequences, resource requirements, competing interests, uncertainty and unintended consequences?

Continuing Reflection and Lifelong Learning

28. What question or way of thinking from this story would you like to carry forward?
29. How might future knowledge and experience challenge, extend or refine this way of thinking?
30. If you later use this way of thinking in a real-life situation, what happened, what did you learn and how would you refine it further?

Suggested Learning Activities and Practical Adoption

Choosing How to Use an IACJ Case: Educators may adapt the activities below to their learners, educational setting, available time and assessment requirements. They are not expected to use every activity. Before assigning a case, the educator should decide how extensively it will be used, how learners will share and document their thinking and whether formal assessment is necessary.

Where group dialogue is planned, each learner should first read the case independently and prepare an individual thinking record. The educator may then use an educator-facilitated classroom dialogue or ask learners to undertake a learner-led group dialogue outside the classroom. Where a recorded group synthesis is required, learners prepare it

after completing the learner-led dialogue. Cross-case and delayed reflection are optional extensions rather than required parts of either approach.

An IACJ case may also support independent, self-directed learning without an educator. It may be integrated selectively into a conventional module to support the teaching of relevant subject knowledge. Where a module is organised around case-based learning, several IACJ cases may be used to support cross-case reflection and progressive refinement of a transferable way of thinking.

A single case may be sufficient in a time-constrained module. Two or more cases are needed only where the educator wishes learners to examine how a way of thinking travels across different stories. Facilitated classroom dialogue is most practical where learners can be organised into small groups, such as groups of five, so that all groups can participate simultaneously.

IACJ cases can be lengthy and should ordinarily be read before the scheduled dialogue. When an IACJ case is used within a module, the educator should select a case that connects with the subject knowledge or learning purpose of that module. In indoor air quality or wider sustainable built environment modules, the case can provide a context through which learners encounter, connect, contextualise and reason with relevant knowledge while developing a transferable way of thinking.

Engagement with the case therefore forms part of the subject teaching rather than an additional activity competing for curriculum time. Where the technical content of the case is not directly related to the module, educators may use the case primarily to support the development of a transferable way of thinking that aligns with the module's intended learning purpose.

Advance Reading and Individual Thinking Record: The educator provides the selected case together with the Primary Reflective Question or a small selection of questions from the reflective question bank. Each learner reads the case independently and prepares a brief individual thinking record. The educator should specify its required form and length. The record may be presented as a short written reflection, an audio recording, a brief video or a simple diagram accompanied by explanatory notes.

Guided by the primary reflective question or selected questions provided, the record may address three simple matters: which part of the story made the learner stop and think; what new question, understanding or change in perspective resulted; and what transferable way of thinking the learner may carry forward to inform future judgement, decisions and actions.

If useful, learners may also note what they believed or took for granted about the issue before reading the case, what remains unclear after reading it and how they now understand the main factors in the situation and the connections among them. The record should capture the learner's initial response to the story rather than summarise its content

or propose an immediate solution to the fictional problem. Depending on how the case is used, the record may stand alone as an individual reflection or provide a starting point for subsequent dialogue and refinement.

Pre-Dialogue Individual Accountability: Before participating in either educator-facilitated classroom dialogue or learner-led group dialogue, each learner submits their individual thinking record by a deadline specified by the educator. The submission must be completed before learners share their records or discuss the case with their group members. It should identify a specific scene, statement, event or relationship in the case that made the learner stop and think and explain the initial question, understanding or change in perspective that resulted.

The submitted record is time-stamped and retained as evidence of the learner's thinking before the group dialogue. It does not need to be graded in detail. The educator may check completion and review a sample of the records or examine a particular record where the learner's later contribution raises questions about prior engagement.

In the final group reflection or consensus video, each learner's identifiable contribution should distinguish between what they initially thought before the dialogue, what they encountered through the contributions of other group members, and how their thinking subsequently changed or became clearer.

Learners are encouraged to build on one another's ideas, as this is an intended purpose of the dialogue. They should, however, acknowledge the contribution, question or perspective that influenced their thinking rather than present it as part of their original response. During educator-facilitated classroom dialogue, the educator may also invite learners without prior notice to explain how a specific part of the case informed their submitted thinking record. This creates accountability without requiring the educator to question all 120 learners individually.

Educator-Facilitated Classroom Dialogue: Where facilitated classroom dialogue is used, each learner brings the individual thinking record prepared after reading the case. At the beginning of the activity, learners are given five minutes to review their records and identify one important aspect of their thinking to share. The educator then organises the learners into groups of five.

Each group is allocated 15 minutes for sharing. Within each group, each learner has approximately three minutes to explain one important aspect of their individual thinking to the other four members. For example, 120 learners can be organised into 24 groups of five. All 24 groups undertake their respective 15-minute sharing activities simultaneously. The educator may then allocate ten minutes for selected groups or individual learners to share important ideas with the whole class. Finally, each group is given ten minutes to record initial notes about what changed or became clearer through the group and whole-class discussions.

Following the classroom session, the group develops these notes into a one-to-two-page reflection of approximately 600 to 800 words and submits it by a deadline specified by the educator. The report should contain a clearly identified contribution from every group member, explaining what changed or became clearer in that learner's thinking and what contribution, question or perspective prompted the change. It should conclude with a group synthesis explaining the transferable way of thinking that emerged, the important points on which members agreed or differed, and what remains unresolved.

The educator assesses both the identifiable individual contributions and the coherence of the group synthesis. The complete in-class activity would take approximately 40 minutes: five minutes for reviewing the individual records, 15 minutes for sharing within groups, ten minutes for selected whole-class contributions, and ten minutes for recording the initial group notes.

Learner-Led Group Dialogue and Consensus Video: The facilitated-dialogue process may be undertaken outside the scheduled classroom session without the educator being present. Each learner first reads the selected case independently and prepares the individual thinking record described above. The learners then meet in groups of five and collectively facilitate the dialogue.

During the unrecorded dialogue, learners follow the same general process used in the facilitated classroom session. They review their individual thinking records, share their individual responses, question and respond to one another's perspectives, identify differences, and refine their thinking. The educator provides the case, reflective questions, and instructions but does not need to attend or review this preparatory dialogue.

After completing the dialogue, each group records and submits one video of no more than 15 minutes. The video presents the group's final consensus or synthesis rather than reproducing the discussion that led to it. It should explain what the group collectively learnt from the case, how its understanding developed, what transferable way of thinking emerged, how that way of thinking could inform future judgement, decisions and actions, and what remains unresolved.

Where complete consensus was not reached, the group should identify the important differences that remained rather than present artificial agreement. Every learner should make an identifiable contribution to the submitted video. In a group of five, each learner may contribute approximately three minutes to one aspect of the group's final synthesis. The video should be presented as one coherent group account rather than five unrelated individual presentations. Assessment should focus on the quality and coherence of the group's thinking and each learner's identifiable contribution, rather than production quality, elaborate editing or presentation performance.

For a cohort of 120 learners organised into 24 groups of five, the educator would receive 24 videos. At a maximum length of 15 minutes each, reviewing every video in full would

require approximately six hours. The approach should therefore ordinarily be applied to one carefully selected case rather than repeated for every case.

Guidance for Educators on What the Learning Activities Should Support: Mental-model development, cognitive abilities and transfer do not need to be assigned as separate activities. The educator may incorporate relevant questions into the individual thinking record, facilitated classroom dialogue, learner-led group dialogue or submitted group reflection. Learners may be invited to explain the outcome that matters, the factors influencing it and how those factors are connected. They may also consider how critical thinking, abstract reasoning, logical deduction, creative imagination and reflective thinking interacted in developing or refining their understanding.

To explore transfer, learners may identify an underlying principle, relationship or reasoning pattern that could remain useful beyond the fictional story. They may consider how it could be adapted to a future problem resembling the case and another that appears unrelated. Learners are not required to decide how either future problem should be solved. The purpose is to strengthen their upstream readiness to think appropriately when adequate real-life information and circumstances become available. Educators should select only the questions relevant to the case and learning purpose rather than require learners to address every dimension.

Cross-case and Delayed Reflection: Where learners engage with two or more IACJ cases, the educator may invite them to identify a way of thinking that remains transferable despite differences in characters, technical subjects, contexts or problems. Learners may explain what remains transferable, what must change between contexts and how the additional case challenged, extended or refined their earlier thinking.

Where sufficient time and subsequent experience are available, learners may also revisit their earlier records after encountering further knowledge, another case or a relevant real-life situation. They may explain whether their mental model, questions or transferable way of thinking changed and whether it influenced how they worked with new information or approached a later problem. Learners should not be expected to claim that transfer occurred when they did not experience it. Continuing uncertainty, absence of recognised transfer and identification of limitations can also support further reflection and refinement. These extensions are optional and are unnecessary where only one case is used or the available time and experience cannot support them.

Assessment and Feedback: Formal assessment is not required every time an IACJ case is used. An educator may use a case solely to stimulate thinking and support engagement with subject knowledge. Where formal assessment is appropriate, the method should reflect the learning purpose, cohort size, available time and marking resources. Where no assessment is required, learners may retain their thinking records and reflections rather

than submit them. The educator should select one manageable form of assessment evidence.

The individual thinking record may be assessed or used only to prepare learners for the subsequent dialogue. Where educator-facilitated classroom dialogue is used, the assessment may consist of the one-to-two-page group reflection described above. Where learner-led group dialogue is used, the assessment may consist of the group's 15-minute video presenting its final synthesis. Educators are not expected to require both a group reflection and a group video. Cross-case or delayed reflections should be assessed only where these optional extensions are included in the learning activity.

Every submitted group reflection or video should contain an identifiable contribution from each learner. Assessment may consider both the quality of each learner's contribution and the coherence of the group synthesis. As the 15-minute video presents the outcome of the learner-led dialogue rather than the dialogue itself, the educator should assess only the thinking and synthesis communicated in the video. The video should not be treated as direct evidence of everything that occurred during the preceding group discussion. Grading should focus on the quality of the learners' externalised engagement with the case.

The educator may consider the clarity of the mental model expressed, the meaningfulness of the questions considered, the connections made among knowledge, context and experience, the recognition of assumptions and uncertainty, the interaction of critical thinking, abstract reasoning, logical deduction, creative imagination and reflective thinking, the reasoning supporting potential transfer, and the willingness to reconsider and refine earlier thinking.

Learners should not be assessed primarily on whether they solved the fictional problem, agreed with the educator or author, selected a preferred decision or predicted one supposedly correct future action. Assessment should instead examine how coherently learners explain the development and potential transfer of their thinking. Feedback may be provided to each group rather than separately to every learner. It should identify strengths in the group's reasoning and synthesis, aspects requiring further clarification or refinement, and questions that could support continued thinking. In a large cohort, the educator may also provide cohort-level feedback addressing recurring strengths, misunderstandings and unresolved questions.

The learners' thinking records, group reflections, video contributions, mental models and accounts of later experience can provide traces of engagement and possible internalisation. They cannot directly measure complete cognitive development, quantify the amount of cognitive governance developed or prove how learners will think or act in every future situation. Educators should also communicate any applicable institutional requirements concerning the use and disclosure of generative artificial intelligence.

Adaptation and Permission: Where an IACJ story is to be adapted into an animation or any other derivative work, explicit permission must be obtained from Dr Moshood Olawale Fadeyi before the adaptation is undertaken.

Origin and attribution: The IACJ Thinking-Trace Approach was developed by Dr Moshood Olawale Fadeyi as part of the IACJ case educational method. It requires learners to document case-specific individual thinking before dialogue and subsequently distinguish their initial thinking from thinking developed through engagement with others. Educators who apply or discuss this approach, whether using IACJ or other case materials, should cite this teaching note.

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