

THE HUMAN FACTOR: EVERYONE'S PRIORITY, NOBODY'S CURRICULUM. INSIGHTS FROM AN ISSW 2024 WORKSHOP

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ABSTRACT: Human factors are widely recognized as central to most avalanche accidents, and avalanche educators can access more content about them than ever before. Far less is known about how they are taught in avalanche courses and whether teaching them changes anything. How can we expect backcountry travelers to make better decisions if we cannot describe what a better decision might look like in practice?

At ISSW 2024 in Tromsø, Norway, we ran a World Café workshop with 45 avalanche educators, mountain guides, researchers, program managers and rescue personnel working in nine different countries. Three questions structured the discussion: What works when teaching human factors? How do we know it works? What does not work?

The level of agreement about methods for teaching was striking. Practitioners trained in different systems and reliance on different certifying bodies converged independently on the same experiential repertoire: engineered field experiences, storytelling, assigned roles, handing the decision to learners, and structured debriefing. Practitioners were equally consistent that presenting biases as a list in the classroom does not work. Regarding how they knew if any of their human factors teaching is effective, the same educators had almost nothing to say. The evidence available to them, such as learner reactions and the quality of a debrief, comes from the moment of instruction, not when the behavior they care about is relevant after the course, at other times on the mountain.

We argue that this is not a missing assessment but a missing outcome. Companion rescue has a specified, observable competence, so it can be taught, practiced and certified. Human factors outcomes, where stated at all, are framed as awareness, and awareness is a mental state that cannot be observed. Actions can. We set out to understand what each of three constraints would require and offer illustrative learning outcomes expressed as observable actions. Each action is paired with evidence an instructor could gather during a course and evidence a learner could generate afterwards. With this, we hope to help put human factors back into the avalanche curriculum in a form that can benefit everyone. For human factors to not remain everyone's priority and nobody's curriculum, the first step is specifying what learners should be able to do.

KEYWORDS: human factors, avalanche education, experiential learning, teaching strategies, learning outcomes, instructor development

PRACTITIONER IMPLICATIONS

- ✓ State what learners should be able to *do*, not what they should know.
- ✓ Hand over the lead. Participant-led tours are your prime window on learner behavior, and it costs no extra course time.
- ✓ Send learners home with a way to keep learning. A portable debrief habit outlives the course.

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1. THE HUMAN FACTOR: EVERYONE'S PRIORITY, NOBODY'S CURRICULUM

Recreational avalanche accidents frequently involve parties triggering avalanches that bury and kill members of their own group, often despite the presence of obvious warning signs and prior avalanche training. As a result, researchers and educators have long viewed decision-making errors, commonly referred to as *human factors*, as a central contributor to avalanche accidents.

Historically, avalanche education addressed human factors through frameworks such as the avalanche triangle (Fredston and Fesler, 2011) and Munter's 3×3 method (Munter, 2017), which treated them as a category distinct from the objective hazards of terrain, snowpack, and weather. In these frameworks, human factors were largely framed as collections of undesirable behaviors, cognitive biases, and dysfunctional group dynamics. More recent approaches have moved beyond these early taxonomies, beginning with McCammon's FACETS framework (McCammon, 2002) and expanding to encompass a broader range of cognitive, emotional, and social influences on risk perception and decision-making (Johnson and Hendriks, 2025; Stock, 2024; Tremper, 2018). Contemporary research increasingly promotes a more balanced understanding that recognizes both the limitations and strengths of human judgment in avalanche terrain (Haegeli et al., 2023; Hetland et al., 2025; Skille et al., 2026). Parallel efforts have examined how recreationists make decisions in avalanche terrain and have produced numerous educational tools intended to mitigate the influence of bias and error (see McCammon, 2026 for a review).

Because this study focuses on educational practice rather than on decision-making itself, we have adopted a deliberately broad definition of human factors as the cognitive, emotional, physiological, social, and other influences arising from interactions among individuals, groups, and the natural environment in avalanche terrain. This definition includes both commonly cited sources of error and adaptive phenomena such as intuition, learning, and personal development.

Avalanche instructors have more material about human factors available to them than ever before. But we also know that they struggle teaching human factors in time-constrained avalanche courses (Dassler et al., 2025). What they do not have is any established way of determining if teaching human factors changes anything. While this problem could be interpreted as a missing assessment tool, the gap runs deeper because assessment presupposes a specified outcome. Avalanche education has long known what competence looks like for companion rescue: locating a buried transceiver within a defined time. Instruction and evaluation have been built around that outcome. For human factors, no comparable outcome has been identified. Without one, instructors have nothing to assess against, and the field has no basis for comparing approaches, improving curricula, or defining effective teaching. The absence of evidence, in other words, is not an oversight on the part of individual educator, it is a structural shortcoming of recreational avalanche education curriculum design that follows from the way the topic has been specified. This study therefore asks not only what educators do, but how they can know when they are effective.

We address this through three sub-questions:

1. How do educators teach human factors, and what do they believe works?
2. What evidence do they draw on when judging that it works?
3. What would have to change for that judgment to be better grounded?

2. HOW WE ASKED: A WORLD CAFÉ AT ISSW 2024

Our data was generated through a half day workshop titled *How should we teach human aspects in avalanche courses?*, held in Tromsø on 29 September 2024, the day after the ISSW 2024 scientific program closed. The workshop applied the World Café method (Löhr et al., 2020), in which small groups discuss a shared problem and then report back to everyone present. Three questions structured the discussion: *What works when teaching human factors? How do we know it works? What does not work?*

Forty-five people took part, 14 women and 31 men, working in Norway, Sweden, Finland, Iceland, France, Italy, the United Kingdom, the United States and New Zealand. They included avalanche educators, mountain guides, researchers, program managers and rescue personnel, along with a few recreational backcountry travelers, with experience ranging from a few years to several decades. Two significant avalanche education communities were absent: Swiss and Canadian practitioners and researchers were invited personally but none were able to attend. This may limit the range of teaching practices our data can speak to.

Discussions were recorded, transcribed verbatim, anonymized, and then the recordings were deleted, under informed consent and Norwegian (SIKT ref. 733888) and international research ethics and data protection requirements. Three researchers coded the transcripts independently, manually and in NVivo, and interpreted them jointly in analysis workshops (Eggebo, 2020). Coding was inductive. All but two of the authors attended the workshop, so we documented our own assumptions about teaching human factors before reading any transcripts.

Throughout this paper, the term *educators* refers to the people who teach avalanche courses, hereby represented by those who took part in the workshop and *learners* to the people who attend the avalanche courses as learning participants. Quotations have been lightly edited for readability: hesitations and repetitions removed, and grammar corrected where participants were speaking English as an additional language. Meaning has not been altered.

3. WHAT EDUCATORS DO

3.1 A topic that arrives last

Aligning with prior findings (Dassler et al., 2025), educators described human factors as important and, at the same time, as the part of a course most likely to be neglected due to time constraint. Compared with terrain, snowpack and weather, the topic is abstract, has no agreed curriculum, and demands facilitation skills that avalanche instructor training generally does not provide. One educator described how the topic ends up positioned in the course flow:

It seems to be at the end of this whole process. So that's maybe why it gets left with less importance or less time and less priority, because it's maybe easier to teach these other things that are tangible and concrete.

Course length compounds this. "Two days is short time to focus on those technical things, so people put the human factor things on the side" another said. Several noted that the problem is not only time relevant but arises in how we prepare avalanche educators: "we don't teach our teachers how to communicate."

The result is that human factors are commonly delivered as a disconnected standalone unit, and educators were close to unanimous that this is a problematic way of doing it. "I don't think it works to just have one lesson about human factors during a course, it's something that should be integrated in everything" as one put it. Opinions differed on timing, with some arguing that learners need a season or two of their own before the topic means anything, and others said that it should run through a course from the first hour.

3.2 What educators said works

Despite the constraints, educators described a rich and remarkably consistent repertoire. Four strategies recurred across every group.

Engineered experience in the field

The most common recommendation was to stop describing human factors and start producing them. "Don't do the hour-and-a-half lecture, live it in the field " one educator said. "And use an example, a concrete example", a discussant added. Poor conditions were treated as an opportunity rather than a problem:

What I think works is, actually, if we get bad weather and just force them to make decisions with a high degree of uncertainty. And then try to sort of highlight it five minutes after they made a decision. Did you now make a decision, or did you just skip making a decision and go?

Others engineered the situation deliberately. One described leading a group to a summit and transitioning fast, so that everyone rushed to follow, before stopping them: "So now that we're all transitioned, we're like raring to go. We didn't discuss anything about this." The reaction, they reported, was audible. "I've seen facial expressions, or like gasps even, that they felt like they missed something crucial."

Narrative

Storytelling, accident accounts and video were used to make the topic personal before it is analyzed. One educator opens with footage of their own accident:

I usually start the human factor by just showing a GoPro video that I have of myself getting caught in a fairly big avalanche. And that kind of puts it into perspective. And then I kind of talk about all the stupid things we did leading up to that.

Assigned roles

Role play was used to expose group dynamics that would otherwise stay invisible, including De Bono's (2017) six thinking hats and an assigned devil's advocate, so that dissent becomes a responsibility rather than a personal risk. As one educator explained, this matters "because it's not easy for people who are not the leader."

Handing over the decision

Educators described stepping back and letting learners run the day: "then you see how they start making decisions and having discussions as a group, when I just pull back and don't run anything and let them run the show." Leadership was rotated in short shifts, and one educator described rehearsing the decision that is hardest to make in the moment: "... practicing turning around, to practice that muscle. Even on a nice day"

Debriefing

Reflection at the end of the day was described almost universally, and often as structured questioning: "Where were we most at risk today? What decisions did we make? What could we have done better? What did we do well?" For several educators it was not a teaching device but a personal habit. "Debriefing is something I personally do every time, every time I go out recreationally or professionally."

Our definition of human factors in this study was chosen to include positive adaptations such as learning from debriefs and improving judgement (see i.e. Skille et al, 2026). However, participants were nearly universal in framing human factors as negative influences, with reflection and learning as separate modalities. While it can be useful to focus discussions on errors and weaknesses, we do not intend to advocate a view of human factors that is limited solely to negative cognitive and social processes.

3.3 What educators said does not work

The consensus here was blunt and near total: the indoor presentation of human factors as a list of biases was ineffective. "For us, what doesn't work are the classes," one educator said. "I can't show PowerPoint and expect them to remember it." Naming heuristic traps was widely seen as producing recognition without changing anything a learner subsequently does in the mountains. This outcome aligns with cautionary advice in the original paper describing heuristic traps (McCammon, 2002) and underscores the need for an alternative to this frequent educational practice.

3.4 A repertoire without a curriculum

What stands out in these accounts is how much agreement there is. Practitioners, researchers and educators working in nine countries, trained in different systems and answering to different certifying bodies, independently converged on the same set of methods, and on the same judgment about what fails. Read as a body of practice, it is a coherent experiential pedagogy: *create the experience, make it personal, make the group dynamics visible, hand over the decision, then reflect on it.*

That convergence is genuinely impressive, and it is also an important sign of the problem our study was intended to address. The agreement is entirely about *methods*. At no point in the workshop did educators converge on what a learner should be able to do differently at the end of a course. The next section examines the consequences of that gap.

4. WHAT COUNTS AS EVIDENCE

4.1 The question the room could not answer

Of the three questions put to the workshop, the second produced by far the least discussion. Several groups moved past it quickly, and the transcripts show why. One group summarized its own deliberation in a single line: "How do you know it works? We said, we have no idea."

This is worth dwelling on. The same educators who had just described, in detail and with conviction, a sophisticated repertoire of teaching strategies could say almost nothing about how they knew any of it worked. The silence was not evasion. It was likely an accurate report of their predicament.

4.2 What educators actually use

Educators named four kinds of evidence used to assess effectiveness of their teaching.

Learner reaction in the moment

The most immediate signal is what happens in front of the instructor: the gasp when the group realizes it transitioned without discussing a decision, the shift in a learner's face when a story lands. This is real information. Instructors used it as an indication that a demonstration had worked. It indicated a response, but it was no guarantee that the impact would be as planned or hoped. Neither did it tell them that anything would be different on their students' future tours.

The quality of the debrief

Debriefing was named more often than anything else, and for several educators it was the answer: "For me, a debriefing is 'how do you know it works' definitely." What a debrief actually measures is how well a learner can reason around and discuss a decision at the end of a day, in the presence of the instructor who taught them how to discuss it. It is a good proxy but a narrow one that should be tested.

Long-term observation

One educator described being able to see transformative change in learners followed over years, typically by watching how they behave when handed the lead. This situation is admittedly rare; it requires a mentoring relationship that avalanche courses are not generally structured to produce.

Follow-up that has not happened yet

Post-course surveys were raised, but as intention rather than practice: "One thing I want to try this season is something like three months post course, like an email survey."

Taken together, the pattern is clear. Nearly every source of evidence for effectiveness available to educators comes from the moment of instruction and not from direct knowledge of what students actually do on their own post-course tours, when that evidence would be the most meaningful.

4.3 The mountain is a poor teacher

Educators might reasonably hope that the environment closes the loop for them, and that learners who make poor decisions will get the feedback they need in low consequence terrain. Often, it does not work this way, and the workshop was clear-eyed about that fact. The overwhelming majority of poor decisions in avalanche terrain are followed by an uneventful and perhaps exhilarating descent. Decision outcome is therefore only weakly correlated with decision quality, and a learner cannot readily distinguish having been right from having been lucky. The feedback signal that would let anyone improve is frequently missing, for the learner and for the educator alike. One educator described the problem precisely:

How people get feedback is something I think a lot about. Like, 'so does this work'? We teach them some stuff, and then they're off on their own, and then they're operating in the mountains. And then what kind of feedback do they get? And who are they with? Are they with other beginners? Do they find mentors? That's a challenge, right, to make sure that people get feedback and learn over time.

The same conditions rule out learning by direct feedback during trial and error, which is the ordinary way that skilled practice develops. In avalanche terrain, the cost of an instructive error can be a fatality. Educators consistently identified this as the hardest limit on their work.

4.4 Nothing to assess against

Underneath all of this lies a more basic problem, which one educator stated as follows:

The learning outcomes aren't clear and it's just not nearly as positive an exchange of information as teaching someone how to turn on their beacon and find someone in the snow.

The problem is not primarily that avalanche education lacks assessment tools for human factors. It is that assessment is independent of actual practice. Companion rescue has a specified outcome, so it can be taught, practiced, timed and certified. Human factors rarely have an equivalent. Where learning outcomes for human factors are stated at all, they tend to be framed in terms of awareness or understanding rather than as something a learner could be observed doing, and outcomes of that form are difficult to assess in any practical way.

Educators in the workshop working across nine countries converged on a shared set of methods, but no comparable agreement on outcomes emerged, and none were available for them to draw on. Without

a specified outcome, an instructor has little basis on which to design an assessment, to distinguish a strong course effect from a weak one, or to compare their approach with their colleagues' approach. Educators are left evaluating their teaching largely by how it felt in the room. The result is summarized in Figure 1.

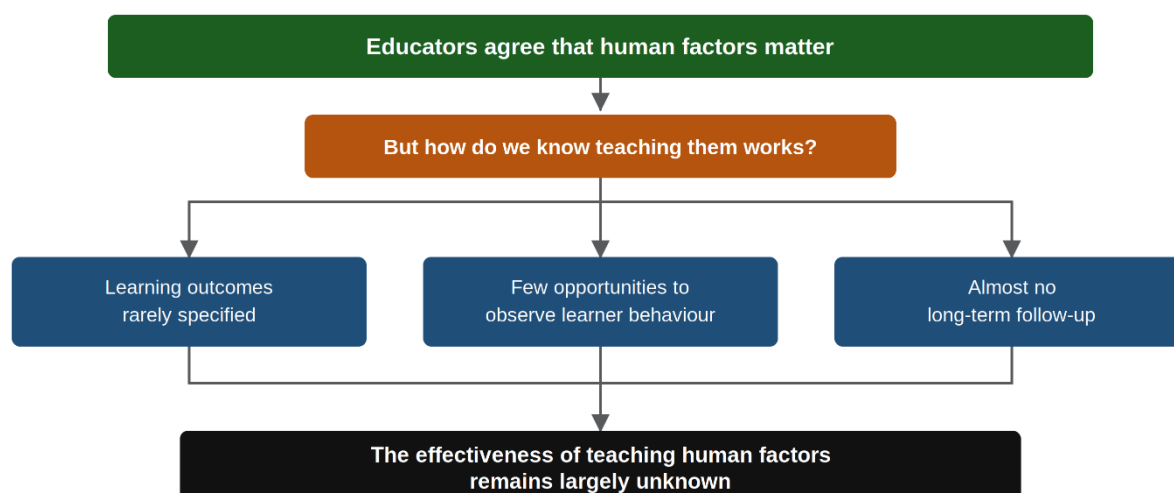


Figure 1: The human factors educational paradox. Educators agree that human factors matter, but in the absence of specified learning outcomes, few opportunities to observe learner behavior, and almost no long-term follow-up, the effectiveness of that teaching remains largely unknown.

5. WHAT WOULD HAVE TO CHANGE

The workshop was better at diagnosis than remedy, and we do not want to overclaim here. What follows are our proposed actions for addressing the three constraints in Figure 1, drawing on what educators described.

5.1 State outcomes as things learners do

Stated learning outcomes for human factors are typically written in the language of awareness: learners will *understand* heuristic traps, will *be aware of* group dynamics, will *appreciate* the role of emotion in decision-making. Outcomes of this form describe a change in what a learner knows, and there is no practical way to observe internal knowledge. Awareness of this kind can of course be tested on paper. But what a written test cannot tell an instructor is what a learner will do on a future slope. In this way, knowledge assessment is disconnected from behavioral evidence.

In the vocabulary of experiential learning, awareness outcomes sit almost entirely in abstract conceptualization. They describe the concept a learner should know, and say nothing about what the learner should notice, do, or try. An outcome that can be assessed externally has to be linked to an observable action, and the useful actions here are mostly acts of noticing and speaking, performed while a decision is still open. Thus, educators should state outcomes as things learners can *do*.

The difference is not cosmetic. The formulations "understands the expert halo effect" and "notices, during a tour, when the group is deferring to one person and speaks up" are not two ways of writing the same outcome. The first can be met by a learner who nods in a classroom. The second can only be met by a learner who does something in the mountains, and it can be seen when they do.

5.2 Use the teaching you already do as the observation window

Educators cannot observe unsupervised learner behavior while they are leading, because a group following an instructor is not making decisions. But educators at the workshop described a strategy that solves this. Handing over the decision, rotating the lead in short shifts, stepping back and letting the group run the day: these were offered by our workshop participants as good pedagogy, and they are simultaneously the prime window in which learner behavior becomes visible.

This might also be the easiest of the three changes, because it asks for no additional time and no curriculum reform. It asks instructors to treat a participant-led day in the mountains as an assessment opportunity as well as a learning one, and to know in advance which two or three behaviors they want to

prioritize watching for. What is currently read impressionistically, as a sense of how a group is doing, could be read against a stated outcome.

5.3 Give learners the means to generate their own feedback

The third constraint is the hardest, because it is structural. Courses end, learners disperse, and the environment returns a signal too noisy to easily learn from. Post-course surveys were raised as an alternative in the workshop and are worth trying, response rates are often disappointing, and they measure recall and intention rather than behavior and practice.

The more promising move follows from something educators already mentioned about their own practice. Several described debriefing not as a course activity but as a personal and social safety habit, carried out after every day in the mountains, professionally or recreationally. If instructors cannot follow their learners, then the object of the course should be to send learners away with the means of generating their own feedback for continued learning after the course has ended. A debrief taught as a portable practice, rather than performed as an end-of-day ritual by the instructor, is a tool a learner keeps.

None of this substitutes for long term mentorship or longitudinal research, which the field needs and largely lacks. But it changes what a course is for. Rather than delivering human factors content in two days, the course equips a learner to learn, and keep learning, about human factors as a natural part of touring practice.

5.4 Worked examples

Table 1 illustrates what this might look like for four learning goals drawn from the workshop discussions. The final three columns correspond to the three constraints in Figure 1: an outcome stated observably, evidence available to an instructor during the course, and evidence a learner can generate afterwards. These are offered as illustrations of the form such outcomes could take. They are not validated, and testing whether they can be reliably observed is precisely the research this paper is arguing for.

Table 1: Four illustrative human factors learning goals, expressed as observable outcomes with in-course and post-course evidence.

Learning goal	Observable outcome	Evidence during the course	Evidence the learner can generate afterwards
Noticing human factors in the moment	Names a social or emotional influence acting on the group while the tour is under way, not only during the debrief	Unprompted namings during a participant-led leg; a learner who produces them only when asked has not met the outcome	Keeps a short tour log recording moments when a human factor influenced the plan
Voicing a concern	States a concern, and the condition that would change their own mind, before the group commits to a slope	Observable in participant-led travel; note whether concerns arrive before or after commitment	Asks partners to state concerns before committing, and notes whether this was done
Adapting the tour plan in real time	Proposes changing an objective when conditions warrant it and gives the reasoning, even when doing so carries a social cost	Set up a participant-led leg where a change of plan is the right call, then wait. Note whether the proposal comes from a learner before any instructor prompt, and how the group responds to whoever raises it	Logs plan changes/decisions and the reasons; an empty log over a season is itself informative and also deserves reflection.
Negotiating risk acceptance	States their own risk acceptance at the start of the day, invites discussion, and identifies where the group's plan diverges from it	Observe whether stated at the trail-head, revisited during the tour, reflected on during the debrief	Written before each tour and compared with what actually happened

Across these examples the in-course evidence takes a common form: whether the learner acts unprompted. A learner who names a group dynamic only when an instructor asks has demonstrated recall. A learner who names it while the tour is underway has demonstrated the outcome.

5.5 What this research asks of avalanche education

None of these three changes can be made by individual instructors alone. Specifying educational outcomes is a focus for certifying bodies and curriculum designers, and is most valuable when different organizations reach consensus so that a learner's competence means something across systems, cultures and traditions.

Observing individual behavior and group practices requires instructor training in facilitation and observation, which our workshop repeatedly identified as missing and that we have seen some instructors desperately ask for (Dassler et al., 2025). Extending the feedback horizon requires course structures that do not end abruptly at the trailhead on day two, and possibilities for learning and research that follow learners beyond the course into their personal tours.

What an avalanche course instructor can do now is the easiest of the three proposed actions, but not the least: integrate human factors into the field days and decide, before teaching, what a learner should be able to *do* differently by the end of the field day and how the instructor would know.

6. CALL FOR ACTION: TOWARD A CURRICULUM FOR THE HUMAN FACTOR

Forty-five workshop participants from nine countries, trained in different systems and answerable to different certifying bodies and organizations, arrived at strikingly similar answers about how to teach human factors: create the experience, make it personal, make group dynamics visible, hand over the decision, and reflect on what happened. They were equally consistent about what is lacking and where practice falls short. On the question of whether any of it works, they rightfully had almost nothing to say.

This gap in assessment is not a failure of instructor diligence. It follows from the fact that human factors are taught toward outcomes framed as awareness, and awareness is a mental state rather than an observable behavior. Without an outcome that names something a learner can do, there is nothing for an assessment to attach to, no way to distinguish a strong course from a weak one, and no way for the field to accumulate knowledge about its own teaching. Human factors remain everyone's priority yet nobody's curriculum.

The solution is not more course content. Avalanche education already has more material on human factors than will fit into a two-day course. What it lacks is a statement of what a learner should be able to do differently at the end of one. Once such outcomes exist, the strategies educators have already developed become assessable. Also, participant-led tours become an observation window, a learning opportunity as well as a teaching device. Finally, and learners can be sent home with the means to generate feedback for themselves and to keep on learning after the course.

There is precedent for this approach. Within a generation, companion rescue moved from vague exhortation to a specified, practiced and timed competence, and instruction improved because it could finally be measured against something. Human factors are still an anomaly. Based on evidence of this workshop, though, they, too, can be given the same treatment and rise to similar measures of learning success.

ACKNOWLEDGEMENTS

We thank the 45 workshop participants - educators, guides, researchers and safety managers who spent a day at the end of a long conference to think hard about a problem none of them has solved. This paper is made almost entirely of what they said, and in addition to inspiring teaching examples several participants were generous enough to describe teaching that has not worked and decisions they regret. Any criticism here belongs to the challenge of avalanche education, not to them: they raised the hardest questions themselves and did not to pretend they had all the answers. We thank the organizers of ISSW 2024 in Tromsø for hosting the workshop, and colleagues at CARE, UiT The Arctic University of Norway, for help with transcription and analysis.

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