FROM KNOWLEDGE CONVEYANCE TO BEHAVIOR CHANGE: AN AVALANCHE EDUCATION THEORY OF PRACTICE

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ABSTRACT: Avalanche education in the US grew out of a need to increase understanding of the nature of the hazard posed by avalanches. Education and training initially targeted professionals who work in avalanche terrain and expert skiers seeking challenge and adventure beyond the bounds of a ski area. As recreational backcountry travel has evolved into a more mainstream activity that includes many modes of travel besides sliding downhill, the target audience of US avalanche education has grown significantly and both diversified in its baseline outdoor experience, as well as in its depth of interest and desire to engage with avalanche terrain. An avalanche educator's instructional skills and ability to establish an inclusive learning environment—in addition to their subject matter knowledge—determine the difference between empowering students to continue safely learning from their experiences and blindly repeating the course's tours regardless of conditions. Recognizing the impact instructors have on the quality and efficacy of a course, AIARE's recreational curriculum and the methods it uses to train AIARE instructors have moved away from basic knowledge conveyance and toward adopting principles of learner-centered education. The goal is to engender behavior change and the adoption of risk management practices in a wider variety of audiences. Our pedagogical approach is to teach scalable processes based on widely accepted best practices using an action orientation. Here, we present some context and the design problem, as well as an explanation of AIARE's scalable teaching process.

KEYWORDS: Avalanche education, risk management education, risk reduction, educational best practices, pedagogy

1. INTRODUCTION

Avalanche education in the US has primarily focused on conveyance of knowledge and skills with the assumption that students' baseline set of starting skills and experience are similar. The American Avalanche Association (A3) publishes recreational curriculum guidelines that define courses by the number of instructional hours, topics to cover, and prerequisites that require basic backcountry travel knowledge. However, as winter recreational backcountry travel continues to grow in popularity throughout the US (Birkeland, 2017), the diversity of experience and motivations of those seeking basic avalanche education broadens. Anecdotally, education providers (A3 2023, AIARE 2019, 2020, 2021, 2023) note that the baseline outdoor travel skills—winter self-care, movement skills, navigation, etc.—are more variable, and in the absence of any other course to learn the skills, students use a Recreational Level 1 avalanche course as the entry point to learn about backcountry travel. This greater variety of starting points provides a greater instructional challenge for educators to ensure all students are meeting learning outcomes. In the case of courses utilizing the American Institute for Avalanche Research and Education (AIARE) curriculum, the outcome all students should achieve is being able to use a risk management process to manage backcountry travel and identify avalanche terrain. The field of cognitive science, a broad multidisciplinary field that includes neuroscience and several branches of psychology, has highlighted the impact an instructor can have on learning by structuring learning experiences responsive to the learner (Bransford, 2000). Incorporating understanding and practices that arise from work in this field is a way to progress avalanche education as a tool to prevent avalanche accidents in the backcountry.

This paper is specifically focused on recreational audiences: those who might participate in a Recreational Level 1 or 2, or an Avalanche Rescue course as defined by the curriculum guidelines published by A3. These participants are specifically interested in recreating in or around avalanche terrain; they are visiting backcountry areas on their days off from work and are thus not defined by professional obligations. On these courses, students are asked to meet a level of diligence more typically

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required while one is on the clock; practices employed by snow and avalanche professionals involve a high level of regular (daily) collaboration and information sharing. The reality for recreational avalanche students is that there is no widely agreed-upon "recreational" version of this practice, and their education is primarily steeped in the conveyance of professional-level skills and understanding. But as St. Clair's Avalanche Bulletin User Typology (2019) indicates, students approach the tools intended to communicate risk to the public with a vast array of levels of sophistication and understanding. We cannot assume monolithic backgrounds or intentions of this audience.

As an educational nonprofit organization that writes recreational avalanche education curriculum, AIARE has focused its curricular design efforts on building scalable frameworks that focus on processes to follow (doing something) and letting those processes dictate what information needs to be conveyed (knowing something) (Riggs Meder, 2020). The intention is to have a common foundational framework that scales to an individual's level of understanding and desired sophistication of usage.

While the design of curriculum is meant to allow scaling of the content, the success of actually scaling the content is dependent on the learning environment and experiences built by an instructor. Avalanche instructors need to teach risk management and decision-making skills for a highly uncertain environment. Students must also learn those skills in a wicked learning environment, wherein feedback is inconsistent and/or not directly linked to action (Hogarth, 2015). They must build experience and judgment over time, when in reality they may only visit the backcountry a few days per season. For education to be an effective tool for preventing avalanche accidents, effective instruction is also required to complement an intentionally designed curriculum. Thus, instructors need to be more than subject matter experts; they must also have strong instructional skills that enable them to adapt to a variable audience and highly dynamic environment.

1.1. Problem statement

A typical avalanche educator in the US does not have formal training as an educator specifically, and because many instructors work multiple winter seasonal jobs, they often do not have the bandwidth or access to educational resources to target this skill.

Recreational avalanche education in North America has been established as an answer to a public safety hazard—whether in response to a specific incident, as in the case of Avalanche Canada (formed after 29 people were killed across the country in the 2002–03 winter, including an incident in which 11 school children were killed in an avalanche in Alberta) or due to the cumulative effect of years of avalanche fatalities, such as the Alaska Avalanche School (created in 1976 by Chugach State Park Ranger Doug Fesler, who recovered multiple victims each winter season).

By and large, these educational programs have been conceived of and executed by teams of people who are subject matter experts in the field of snow and avalanches. As the scale of recreational avalanche education has grown, organizations have incorporated input from education and design research and practitioners in an ad hoc fashion. However, many organizations that provide avalanche education are small and often also provide services such as public forecasting or active mitigation, requiring their staff to fulfill numerous roles simultaneously. As such, they are not necessarily in a position to employ specialists or dedicated curriculum or learning professionals.

Presently, there is an opportunity—and much to be gained—for the avalanche industry to more deliberately and permanently incorporate advances in our understanding of learning, teaching training, and content-specific pedagogy in order to further improve avalanche education as an effective tool for preventing avalanche accidents.

Importantly, students who participate in voluntary avalanche education have a wide variety of backgrounds and motivations. The evolution of avalanche education has been to incorporate more information as understanding of avalanche phenomena has grown. As a result, the primary challenge of a 24-hour Recreational Level 1 avalanche course in the US has been how to cover as much content as possible with the hope that this will equate greater knowledge and understanding of the phenomena and lead to the ability to avoid involvements. Much avalanche education in the US today could be described as "expert-centered"; in other words, subject matter experts seeking to convey what they know to students. While many instructors acknowledge the wide variation in starting skills and knowledge, expert-centered conveyance is structured with a fixed baseline, usually one that corresponds to where the expert themselves started, making it challenging to respond to variation. This style can be ill-matched to an elective adult education course that has no

prerequisites, as it is impossible to ensure or even know whether participants' baselines actually correspond to the experts'.

As noted in the National Research Council publication *How People Learn* (Bransford, 2000), "expertise can sometimes hurt teaching because many experts forget what is easy and what is difficult for students." Instructors who are fulfilling numerous wintertime roles are thus likely to default to teaching in the same fashion in which they learned, thereby replicating their personal learning progression and path of knowledge and skills acquisition, which may not serve the student's. Since skills are built in a progression, not starting at a student's actual place on that progression can result in the student falling back to ideas and habits they relied on before the course (Bransford, 2000). This challenges the presumption by the instructor that learning outcomes are achieved, especially as instructors do not necessarily have any post-course interactions or opportunities for follow-up educational experiences with students.

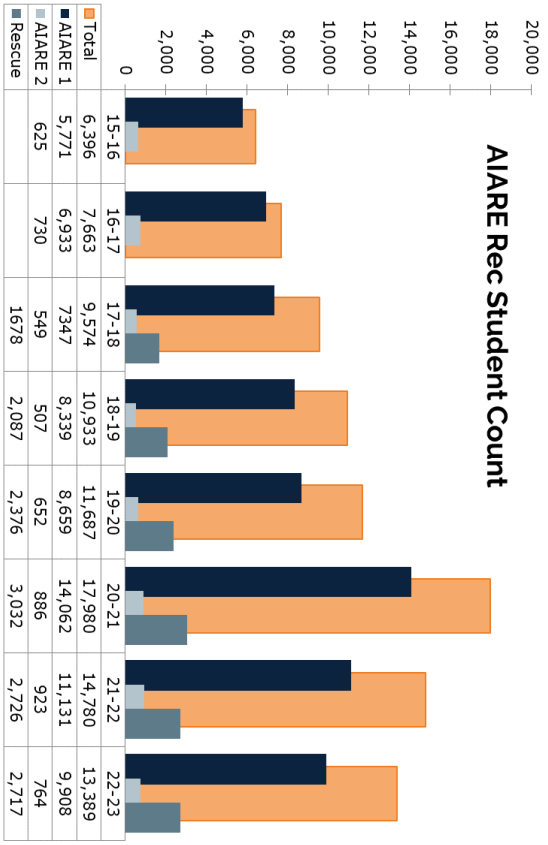

Figure 1: Count of AIARE recreational students by season and program, beginning with 2015–16 season and ending with 2022–23 season.

Over the past eight seasons, AIARE students (AIARE saw a total of 92,402 instances of participation in recreational courses during this time period; see Figure 1) have indicated a variety of motivations and goals, both in feedback we have received from students themselves and from the answers they provided to our annual demographic survey.

Over the past three seasons (beginning in 2020–21), AIARE has collected demographic information from students using a voluntary survey provided at the beginning of the online learning portion of each AIARE recreational course. During the 2022–23 season, 10,322 students (77% of AIARE recreational students) responded to the survey (see Table 1). The variety of primary modes of travel students reported, for example, provides a glimpse into the variety of motivations students may have for taking a course—after all, a snowmobiler or snowshoer, by definition, has different objectives in a backcountry setting than a skier.

2022–23 AIARE Recreational Student Demographics				
Mode of Travel	**Rescue**	**AIARE 1**	**AIARE 2**	**ALL**
Ski	66%	64%	70%	65%
Snowboard	21%	22%	19%	22%
Snowshoe	7%	8%	1%	8%
Snowmobile	4%	3%	8%	4%
Other Entries	2%	2%	1%	2%

Table 1: Primary modes of travel reported by AIARE recreational students in the 2022–23 season.

Adding to the complexity of this issue is that students may not always recognize the level of effectiveness of their education. Because avalanche courses are elective and adult students are choosing to pay for an experience, there is an element of satisfaction with perceived learning that is crucial to achieving student buy-in. As a result, if instructors deliver an entertaining or satisfying experience, a student who had an enjoyable time may conflate that experience with meeting learning outcomes, and they may not in fact be significantly more prepared to manage their risk in avalanche terrain than they were before participating in the course.

1.2. Project aims

This paper outlines a scalable pedagogical approach for avalanche educators. It is a model for building student centered learning experiences that provides an instructor concrete evidence that their students are meeting the

learning outcomes. This process prompts instructors to name a clear action or benchmark to observe to tangibly know the difference between a feeling of satisfaction with how the course went and having direct evidence that learning occurred and/or behavior change took place.

The A3 education guidelines outline teaching simple decision tools to facilitate communication and terrain choice. AIARE has focused on this outcome, developing a repeatable daily risk management process. Taking into account student starting skills and knowledge variability, the process was designed to scale to be usable both by users seeking to make simple decisions about avoiding avalanche terrain and to expert travelers looking to engage with avalanche terrain (Riggs Meder, 2020).

This scalable process provides curricular support to adapt to the variable starting points of students participating in recreational courses. The next step is to increase the efficacy of the instructor and the impact they have on meeting learning outcomes on a course. The issue is that most avalanche instructors are not trained teachers; it would likely be unreasonable to expect that professionals maintain qualifications as emergency first responders, guides, forecasters, ski patrollers and/or blasters, and a long list of other seasonal jobs held by avalanche instructors to also have and maintain a certified teacher's level of training. AIARE sought to replicate the development of a scalable risk management process to create a scalable instructional process that is applicable and useful to both novice instructors and highly experienced educators.

Because the primary audience for recreational avalanche education is adults and due to the unique challenges posed by elective education, we drew from the work of Malcom Knowles, an educator who developed a theory of andragogy (teaching methods specific to teaching adults). Knowles (1975) made a set of assumptions about adult learners to describe the unique characteristics that differentiate an adult learner, as opposed to the learning associated with youth and youth development. From these assumptions, he developed the following four principles to guide the development of instruction directed at adults.

1. Adults should be involved in planning and evaluating their instruction.

2. Experience, including mistakes, is the basis for the learning activities.

3. Adults are most interested in subjects that have immediate relevance to them.

4. Adult learning is problem-centered, rather than content-oriented.

2. METHODS

We used the aforementioned principles as a foundation to design a simplified process avalanche instructors could use that would apply to most every teaching situation they would encounter.

2.1 Involve learners in the planning and evaluation of their instruction

To involve students in their own learning requires everyone involved to understand (1) where the learner is starting, (2) where the learner should end up, and (3) the path or steps required to get there. In other words, both the student and the instructor must be clear on the end goal (learning outcome); the instructor needs to understand the progression of skills and knowledge required to reach that end goal, and both the instructor and the student must understand where the student is starting in relation to the learning objective.

For the first part, the student needs to not only understand the desired end goal and outcome, but also know the skills and actions that indicate they have achieved the desired goal. Since students are often novices, they may not yet have enough skills or experience to accurately assess the quality of their skills or if they have met the outcome. Therefore, the more explicitly the instructor can describe the end goal as an action—something the student is able to do, as opposed to something they "know," which is intangible and thus more difficult to quantify—the better the student can take part in assessing their progress and in planning for how they will meet the goal.

For the second part, the instructor can use their knowledge of the student's starting position within the progression and knowledge of the appropriate skills progression to provide instruction responsive to the individual student. Taking specific knowledge of the student and of the skills progression into account, the instructor can provide a learner-centric experience rather than simply executing a progression with fixed starting and ending points that ignore the student's positioning.

For the third part, an instructor needs to define the progression of skills or knowledge understanding that leads to achievement of the outcome. This benefits the instructor by centering the student and moving beyond rote repetition of the instructor's own personal skills progression. It also benefits the student's understanding of the skills progression required to achieve the learning outcome.

2.2 Experience should provide the basis for learning activities

Because skills progressions are the basis for achieving goals within this model, instruction should focus on action over just knowing or understanding something. This provides the learner ample opportunity to practice and improve skills, further involving the learner in assessing their progress towards the goal.

2.3 Learners prioritize subjects that have clear relevance and impact to them

The learner's perception of relevance is a function of the instructor's ability to clearly communicate how students' actions support safe backcountry travel, as well as an instructor's ability to understand the student's current skills and knowledge and make connections to that.

2.4 Adult learning is problem-centered rather than content-oriented

A clear goal supports the relevance of the actions required to achieve the goal. Centering the student and the action(s) the student needs to be able to perform focuses both the instructor and the student on the "problem" to be solved, rather than a recitation of content to be understood (the latter approach leaves it to a novice learner to sort out how to the content is relevant to their goals and aims).

Considering these four design principles, three essential structural elements of an instructional plan begin to emerge. An instructional plan, often called a lesson plan when referring to the way an instructor teaches a specific topic, should include:

- A clearly communicated, action-oriented goal
- A targeted understanding of a student's skills and experience
- Identification of the progression of skills needed to reach the goal

These elements support the creation of instructional plans that adhere to Knowles' four instructional principles and that share common elements with the best practices taught in formal teacher training and certification programs.

The additional design constraint is to combine these elements into a process that scales to a variety of types and complexities of skills and content, as well as being scalable to the instructional skills of the instructor. It needs to be easy to apply as a novice or as an individual with less sophisticated instructional skills.

3. PROCESS

In this section, we will describe AIARE's instructional process. This is the process taught in the AIARE Instructor Training Course (ITC), the five-day course intended to deliver essential teaching tools to subject matter experts. Prerequisites for this course include at least five years of experience traveling in the backcountry, a PRO 1 certificate from an A3 professional course provider, and familiarity with the AIARE curriculum specifically by having participated in an AIARE 1, AIARE 2 and AIARE Avalanche Rescue Course. This last requirement ensures that participants are already familiar with the curriculum itself when beginning an ITC. The intention of the course is not to reinforce or even check for subject matter expertise, but to give participants educational tools and allow them to practice using those tools in the presence of their peers and the career educators who teach the ITCs. The process is as follows.

3.1. Name a goal

A high-quality goal is clearly connected to the bigger goals of the course, as well as being very specific so that a student understands both where they are going and how to know when they have arrived there.

One of the best ways to do this is to name a specific action that students will be able to take at the end. This is sometimes called backwards planning (Wiggins & McTighe, 2005): name the desired ending, then only do what contributes to getting to that ending.

3.2. Understand and connect to the student

Instruction, by definition, is supporting the learning of a student. This means an instructor must understand the student they are working with, both in terms of the student's motivation in relation to the goal and the student's skills and knowledge. Instructional planning should include activities targeted to build rapport, discover what a student already knows, and build a student's understanding of the problem and its relevance to the learner.

3.3. Move through a skills progression

The skills taught on an avalanche course have a specific progression. In planning, instructors

should be able to lay out the progression of skills, if possible named as a series of actions that lead the student to the end goal. This supports the instructor in pinpointing where the student is on that progression of skills. High-quality instruction makes these skills clear to the student, involving them in monitoring their own progress by providing waypoints. A series of actions keeps instruction focused on experience and practice over dissemination of content. The progression is broken into bite-sized pieces, with a sequence of instructions and applications for each bite-sized piece.

A skills progression that focuses on actions the students will perform aids the instructor in monitoring progress throughout the lesson. This avoids getting all the way to the end of a lesson, realizing the student has not met the goal, and not knowing which part the student misunderstood or missed in achieving a critical skill in the progression. An ideal progression provides ample opportunity to check, stop, and fix before moving on, ensuring a solid foundation on which to build the next set of skills.

4.1. Check that the student met the goal

Naming the lesson goal in the form of an action the student will perform provides an explicit check that the student has met the goal. The instructor should see every student perform the action.

4. DISCUSSION

As mentioned in the previous section, this structure is the basis for the AIARE Instructor Training Course; all providers who use the AIARE curriculum are required to use instructors who have completed this course and who maintain their status by participating in annual continuing education. This training primarily focuses on avalanche-specific instruction, on learning this process, and on practicing it by teaching elements of the AIARE curriculum. We continue to disseminate the process to more seasoned instructors who completed their ITCs before AIARE developed the process via continuing education workshops. AIARE continues to build curricula that support novice instructors in using this process; for example, workshops designed specifically to build action-oriented goals and/or to employ various teaching methods to build and progress through skills.

4.1 Limitations

This is a process based on a practice taught in many teacher training programs and applied to the field of avalanche education. A typical practitioner in avalanche education has had less formal training than a typical practitioner of, for example, elementary classroom education, who generally completes a multi-year teacher training program. These programs are often built on evidence based practices of teacher efficacy and teacher training efficacy. Additionally, AIARE's pool of over 600 instructors nationwide have received their ITC education from a number of different instructors and at a number of different points over the last 25 years. Not only do we have to consider the efficacy of the instructors trained on an ITC, but also the efficacy of the trainers who trained them. Bringing everyone onto the same page can be likened to playing a game of telephone.

At present, we have limited knowledge of instructor fidelity in applying this process. Because AIARE does not directly employ instructors (instead, they are employed by AIARE providers), it is challenging to understand how well AIARE is training instructors, how well they perform in the field, and finally, the impact this has on the recreational user.

5. CONCLUSIONS

Looking ahead, now that AIARE has developed and begun to disseminate a process, the process can be refined and improved over time. In subsequent seasons, we plan to formally evaluate the impact of this process on instructor efficacy, as well as incorporate learning and practice from the learning sciences into future improvements.

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