Review of Key learning moments as predictors for understanding snowpack dynamics during a season-long avalanche course? by T. Dassler et al.
Anonymous reviewer

Authors and editors,

The longitudinal research project described in this manuscript investigated the participant learning on a non-traditionally structured avalanche education course using mixed methods approach. The article focuses on the quantitative analysis of the learning outcome metrics. Data were collected with pre/post surveys, participant activity logs and observer memos, and analyzed to measure the impact of self-reported key learning moments on knowledge about snow stability, and awareness on personal knowledge gaps. The results were non-conclusive in a quantitative sense, however, they provided interesting insight as a case study of avalanche course participants' knowledge and skill retention.

Overall comment:

Avalanche education is an understudied field, and the article offers a contribution to our understanding of the efficacy of avalanche courses. The third research hypothesis is clever; approaching education as an opportunity to establish one's own knowledge gaps is brilliant. There is much value in this train of thought, including the authors' recommendations for providing repeated and novel opportunities to life-long learning for mountain travelers(L611).

Despite the potential benefits of this paper, I have some fundamental concerns about the employed methods and the interpretation of the quantitative results. In my opinion, addressing these issues requires a substantial repositioning and rewriting of the manuscript before it can be considered for publishing.

Here are the topical comments on the manuscript focusing mainly on high level points about the methodology and results; I am not providing line-by-line comments for this version.

Main concern is the limited data set:

The dataset is very small (8-10 participants) for the application of linear mixed models or Chi-square tests (L279). The number of key learning moments in the dataset is neither included in the article nor the supplemental materials. The authors applied Cramer's V, that is less sensitive to sample size, and pivoted to using effect size when discussing the results. Yet it seems likely that the data set is not viable for Chi-square testing and that extremely small sample can influence the strength of associations used in the results. The results may not be generalizable.

If the article's objective is to share the quantitative results (L19-21; section 2.3), this goal is out of reach due to the limited sample size. The present focus on a quantitative analysis seriously distracts and devalues from more valuable qualitative insights that the study could provide. Hence, reframing the inquiry as the exploration of qualitative insights from the survey data would be more appropriate objective for the manuscript considering the available data set.

Connecting the dots was difficult:

The lengthy introduction discusses foundational experiential education literature combined with more current references on effective and transformational learning theories and a short list of relevant articles on avalanche education research. Notably missing is McNeil et al. (2023) that addresses topics of L53-55. Editing the introduction to focus on major theories related to key learning moments, knowledge acquisition, and the role of snowpack information in avalanche decision-making, would prioritize the content that is most relevant for the results and discussion.

It was difficult to follow the connection from hypotheses to conclusions. This may be due to the unclear explanation of the results or the verbose and ambiguous language. If the connections between research questions, theory, data, analysis, and results would tie together more coherently, it would be much easier for readers to understand the conclusions and implications of the study and how well they are grounded in theory and the collected evidence.

<u>Key learning moments</u>
Here are three examples that create convolution related to the title concept, key learning moments (KLM) (Section 1.3), the metric the authors emphasize as a major factor in the efficacy of education:
1. There is no data of KLMs included in Section 2.1 or elsewhere in the paper.
2. In the results section, statements on the variable associations with KLMs are hard to understand (L348-353).
3. X axis on Figure 3 (L370) is labeled "average KLMs", but it is unclear if this number is average KLMs per trip or an overall mean of KLMs per participant during the study period; a clear caption would clarify the figure interpretation.

<u>'Why to ski'</u>
Another mind bender was the 'why to ski' construct the authors use to measure the participants reasoning to decide that it was safe to engage in the activity. The 'why to ski' score is introduced in section2.2 (L267) without a transparent connection to research question about students' ability to apply their knowledge on their own(L154) or their confidence to justify their field decisions (L164). On a different note, the focus on the term 'ski' perpetuates the imbalance in the representation of various mountain activities in avalanche safety research. Even if the dataset consists solely of skiers, the researchers could use more inclusive language when presenting their findings.

Snowpack analysis lessons

An additional content gap is the missing information on what was taught about snowpack analysis. The authors refer to standardized curricula from Norwegian Mountain Forum (L209) but also that the participants had their say about the content (L157). Including the actual snowpack topics covered, practiced, and reviewed in each module would be informative as an appendix to explain the educational delivery of 23 snowpack factors measured(L164) and analyzed(L260).

Contributing factors outside the course participation:

Factors outside the participation in an avalanche education experiment can contribute to the scores in your data; for example, learning moments that happen on personal tour days can build competency. It is possible that the participants engaged in active experimentation outside the course modules (L403). Were these data (L287-293) collected from the participants repeatedly or only once for a baseline? And more generally, did the authors consider how to contextualize the results into the participants' individual lived experiences – not only as participants of four education modules? There is much potential for deep descriptions on the individuals over the repeated interactions with ethnographic approach (Dammler et al., 2023), but that rich viewpoint is missed in this paper. By reframing the paper, the authors could provide a more detailed introduction of their participants, highlighting them as key players in the case study.

Explanation of how all the parts of the project fit together:

As a part of a larger research project, the article made references to other papers related to the education experiment (i.e. L135 and 165), which was slightly distracting for this specific piece. I needed to locate and read the other articles mentioned in the text to get the full understanding. It would have been helpful to have a concise reference to a holistic framework of how the different pieces fit together, perhaps as a flow chart or a table rather than the introductory paragraph in Section 2.2. Sharing the necessary information from the adjacent articles clearly and concisely would improve the thread of the manuscript.

References:

McNeil, K., Morgan, J.A., Riggs Meder, L.Y., and Walker, E.R.: Understanding backcountry behaviors after participation in a recreational avalanche course. In: Proceedings of International Snow Science Workshop, Bend, Oregon, 8 October, 2023. pp.1112-1119, https://arc.lib.montana.edu/snow-science/item/3020