

# How to Teach Machine Learning in an Engaging Way

## Related Literature

- [1] P. Steinbach, H. Seibold, and O. Guhr, "Teaching machine learning in 2020," in Proceedings of the First Teaching Machine Learning and Artificial Intelligence Workshop (B. Bischl, O. Guhr, H. Seibold, and P. Steinbach, eds.), vol. 141 of Proceedings of Machine Learning Research, pp. 1–6, PMLR, 14 Sep 2021.
- [4] W. Chow, "A pedagogy that uses a kaggle competition for teaching machine learning: an experience sharing," in 2019 IEEE International Conference on Engineering, Technology and Education (TALE), pp. 1–5, 2019.
- [12] C. Gresse von Wangenheim, J. Hauck, F. Santana Pacheco, and M. Bueno, "Visual tools for teaching machine learning in k-12: A ten-year systematic mapping," Education and Information Technologies, vol. 26, pp. 1–46, 09 2021.

## An Analysis of Machine Learning Teaching Methods Aimed at Student Engagement

### 01 Introduction

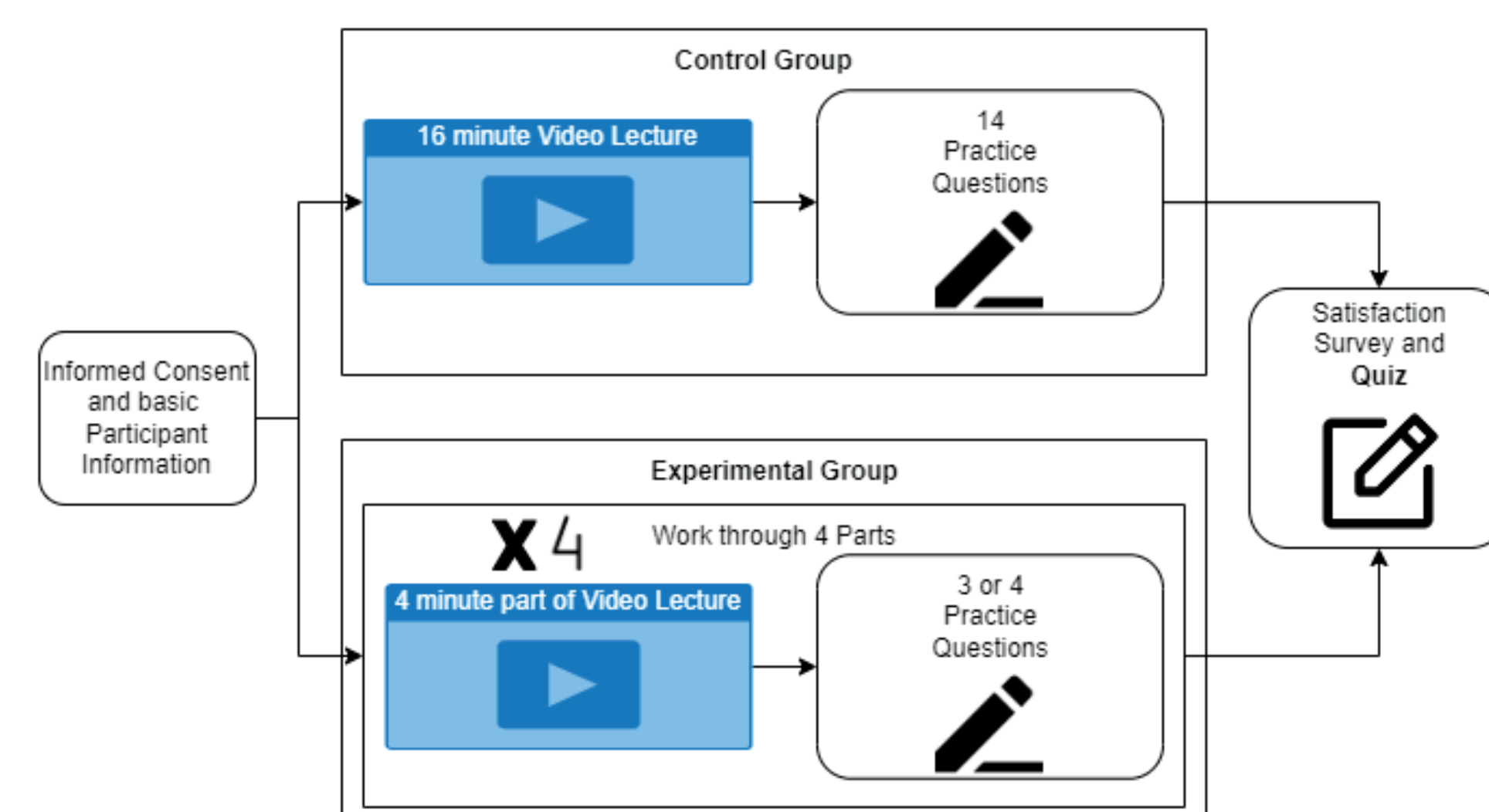
- Machine Learning (ML) topics can be complex and difficult to follow
- There is some previous research on the effectiveness of engagement-focused teaching methods for ML [1], but it is not very in-depth, and there are ample calls for more [4] [12]
- The impact of engagement-focused methods on learning outcomes remains vaguely defined
- This study aims to bridge this knowledge gap with a controlled experiment

### 02 Research Question

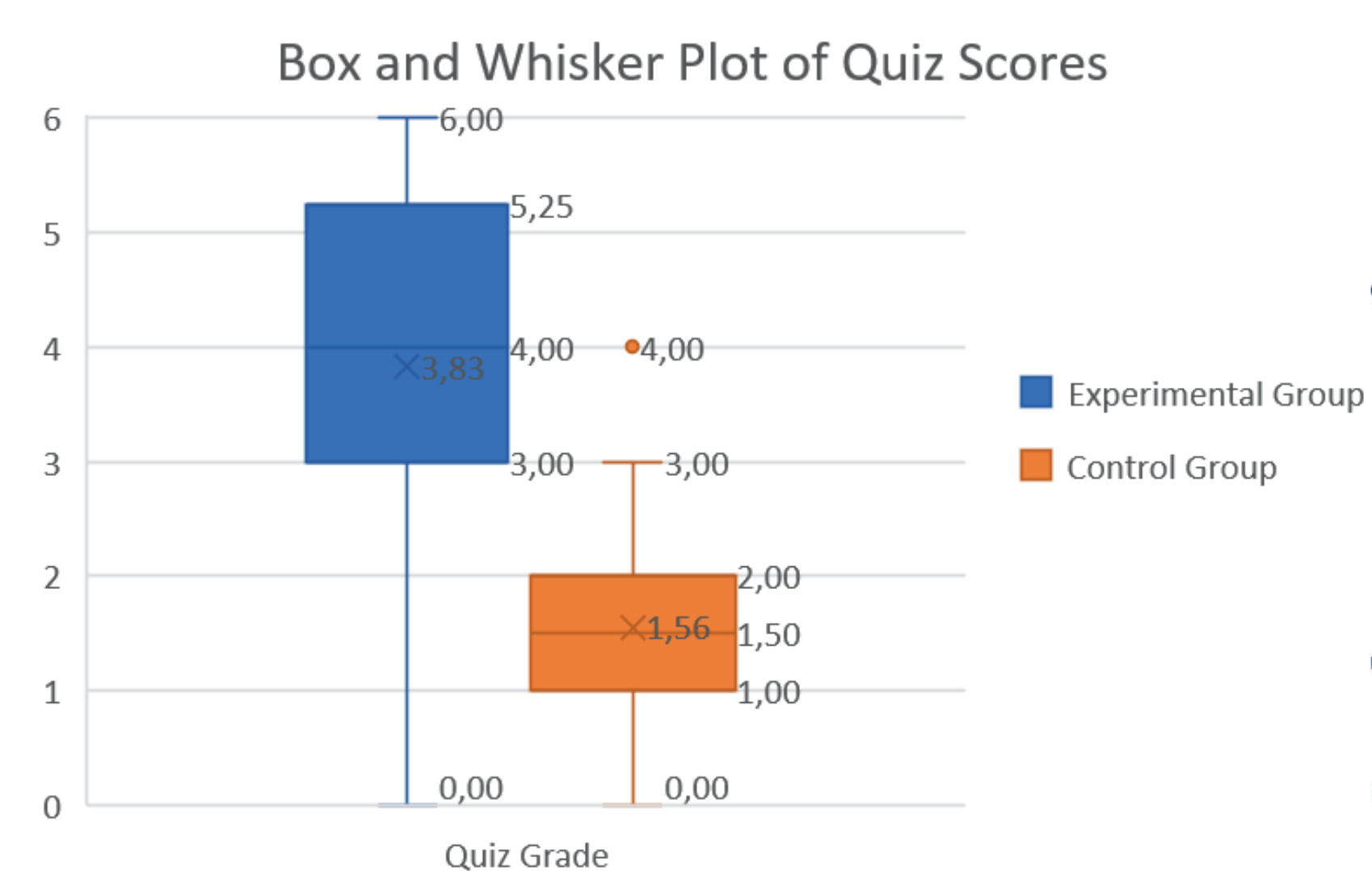
"To what extent do Machine Learning teaching methods focused on student engagement improve learning outcomes as measured by test performance and student satisfaction?"

### 03 Methodology

- Control group: conventional 16-minute video lecture covering the basics of the concept of artificial neural networks, followed by 14 practice questions
- Experimental group: same but broken down into four parts, each consisting of a roughly four minute video followed by three or four practice questions.
- Both groups complete the same satisfaction survey and quiz



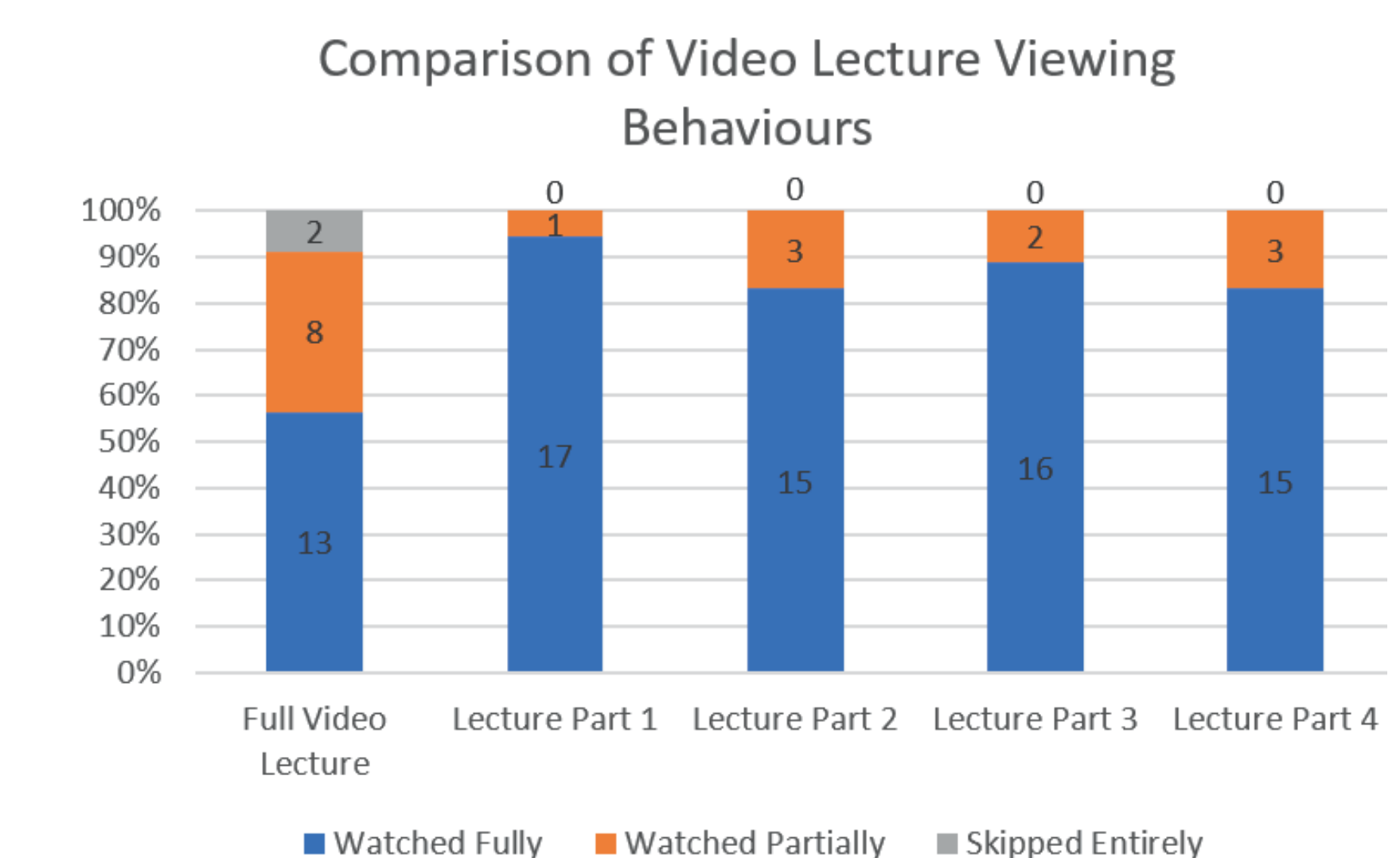
### 05 Experiment Results



The experimental group performed significantly better in the quiz, with an average score of 3.83 out of 6. This, in contrast to the control group's average quiz score of 1.56 out of 6, makes for a staggering improvement, suggesting that the engagement-focused approach is overwhelmingly more effective in this regard.



In terms of the satisfaction ratings reported by participants, the experimental group is in the lead in all categories, although by a narrower margin



As evidenced by their video lecture viewing behaviour, the experimental group had much higher levels of engagement (columns 2 to 5) than the control group (column 1)

### 04 Ethical Research

- Participants' privacy was protected by keeping the experiment entirely anonymous and excluding individuals whose data could potentially lead to their identification.
- The well-being of participants was prioritised by making it clear that every part of the experiment is entirely optional and carries no consequence to participants, thus minimising the risk of psychological distress.
- Aligns with the TU Delft Vision on Integrity 2018-2024 and the Netherlands Code of Conduct for Research Integrity 2018
- Pending approval of this study from the TU Delft Human Research Ethics Committee

### 06 Conclusion

Overall, the results of this study provide significant evidence that even a simple engagement-boosting technique, such as breaking down a lesson into smaller, more manageable parts, can have a profound impact on learning outcomes, as measured by test performance and student satisfaction.

#### Limitations

- Relatively small number of participants
- 30-minute experiment is both too short and too long
- Only one engagement-boosting technique was used
- Motivation of participants

#### Future Work

- Conduct a similar experiment with (many) more participants and over a longer period of time
- Expand the scope of the experiment with more engagement-boosting techniques
- Provide incentives for participants to increase their motivation