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How **Machine Learning** concepts can be remembered for the rest of our careers with the right **practice questions**

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BACKGROUND

TU Delft's **machine learning** (ML) course **CSE2510** is many students' introduction to the subject. Research on teaching methodology for ML is still a work in progress. CSE2510 is a packed course. Coding exercises do not cover all the material, so regular practice questions are used. These don't always for reasoning to an answer.

Elaborative interrogation, "generating an explanation for *why* an explicitly stated fact or concept is true", has great benefits to memorization and understanding of a concept.[1] Its potential in practice for ML has been explored in this study.

METHODOLOGY

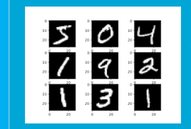
Two **elaborative interrogative practice questions** (EIPQ) creation techniques were developed:

1. Turning closed, multiple-choice ML practice questions into EIPQ:
   The original ML question's answer gets put into the EIPQ question

The arrows in the figure indicate:
- The training example's labels
- The training example's measurements
- The training example's features
- The test example

Why do the arrows indicate the example's features?

2. Creating EIPQ based on real-world ML problems:



This is the MNIST dataset classification problem.[2] What algorithm would you use to solve this and why?

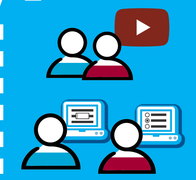
EXPERIMENT

30 participants split into group 1 and group 2.

Day 1

All participants first watched an educational video on ML, then individually answered a set of practice questions

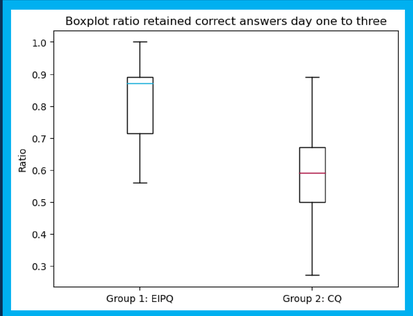
group 1 EIPQ
group 2 CQ: control questions

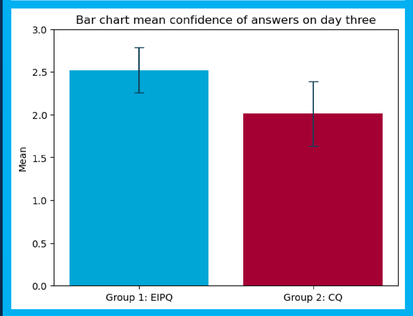


Day 3

All participants answered CQ set, with added confidence indication

group 1 CQ with confidence
group 2 CQ with confidence





RESULTS

Group 1 (EIPQ) outperformed group 2 (CQ) on all metrics

Three metrics were employed:
- Correctly retained answer from day one to three
- Difference score day one to three
- Confidence means

These were then also compared based on the question creation method, with both methods providing statistically significant results in favor of EIPQ.

Scores were adjusted based on indicated confidence, all metrics remained statistically significant in favor of EIPQ

Prior to no prior knowledge seemed to have insignificant effect on the results.

CONCLUSIONS

Elaborative interrogation proved incredibly effective in aiding knowledge retention for introductory machine learning content.

Two methods can be utilized for the creation of practice question, with both providing unique advantages:

Method one requires minimal changes to CSE2510 curriculum, retaining a question's original bloom level and learning objective.[3]

Method two introduces real-world examples, allowing continuous engagement in various machine learning algorithms.

Its inclusion in CSE2510 is recommended, provided it can receive a test-run.

FUTURE WORK

Knowledge transfer between abstract problems and concrete problems can be analyzed.
"Self-explanation"[1] can provide similarly interesting results, specifically for math this could prove useful for computer science students..
Time intervals can be tested to provide arguments for strength in retention

REFERENCES

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[2] T. Penumudy, "A Beginner's Guide to KNN and MNIST Handwritten Digits Recognition us- ing KNN from Scratch," Analytics Vidhya, Jan. 29, 2021. https://medium.com/analytics-vidhya/a- beginners-guide-to-knn-and-mnist-handwritten-digits- recognition-using-knn-from-scratch-df6fb982748a
[3] D. R. Krathwohl, "A Revision of Bloom's Tax- onomy: An Overview," Theory Into Practice, vol. 41, no. 4, pp. 212–218, 2002. Available: http://www.jstor.org/stable/1477405

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