Proposal of a Method to Articulate the Knowledge and Ideas in the Decision Making Process in AI-Human collaboration

Yichuan Zhang
Supervisor: (Professor) Kazuo Hiekata

As AI technologies rapidly advance, knowledge transfer emerges as crucial for sustaining competitive advantage through expertise sharing. While traditional methods play an important role, they face limitations in today's dynamic environment. This paper explores how AI is changing knowledge transfer approaches, especially between explicit and tacit knowledge forms.AI serves not only as a new medium but enables human-AI collaborative training. It facilitates expertise conveyance beyond traditional boundaries. However, knowledge transfer also encounters new challenges in the AI era, such as how to effectively codify, decode and explain knowledge through technology. By analyzing a case study on Tokyo Electric Power Company's demand forecasting adoption of AI-augmented methods, the paper demonstrates how such novel approaches can address limitations faced previously. Insights gleaned provide guidance on addressing knowledge transfer bottlenecks as AI continues to progress.

Keywords: Knowledge Transfer, Human-AI collaboration, Electricity demand forecasting, Unexpected event forecasting, Decision-Making support.

1 Introduction

Knowledge transfer is crucial for organizational learning and competitiveness. However, it faces challenges due to the tacit nature of knowledge and differences in contexts. This research explores an AI-enabled, data-driven approach to knowledge transfer using behavioral logs. It records experts' entire decision processes during a prediction task and visualizes workflows. This allows context preservation and process understanding for recipients. The method is applied to an electricity demand forecasting task combining domain and technical knowledge. It demonstrates the potential of human-AI collaboration in knowledge transfer and sharing.

2 Literature Review

Spitzer & Goutier proposes a framework to utilize human-AI collaboration for knowledge transfer from experts to novices through explicit and tacit knowledge [1]. Garavelli et al. provide a cognitive perspective on defining knowledge technology properties based on the requirements of different knowledge transfer contexts [2].

3 Objective

The objective of this study is to explore an AI-enabled approach to capture task-specific expert knowledge (TSEK) through behavioral logging and workflow analysis within a human-AI collaboration (HACI) environment. It seeks to examine how HACI can effectively log and contrast the decision-making processes of experts and novices with/without technical backgrounds, in order to understand differences in knowledge manifestation and enable knowledge transfer from experts to novices.

4 Proposed Methods

This research methods bring a novel data-driven approach to knowledge transfer using human-AI collaboration. By logging experts' full decision processes during task execution and leveraging AI techniques to reconstruct visual workflows, it achieves tacit knowledge formalization and context preservation. The approach facilitates knowledge absorption and application by enabling process understanding for recipients. Moreover, the behavioral log analysis and workflow optimization present new possibilities for dynamic knowledge sharing platforms. This human-in-the-loop method signifies an innovative direction to augment traditional knowledge transfer limitations across diverse domains involving both specialized and technical knowledge.

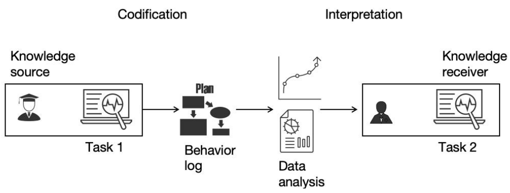

Figure 1. Framework in HACI designed framework

The key components as shown in figure 1 of the proposed knowledge transfer framework are: 1) Behavioral logging of expert workflows and decision making processes during task execution. 2) Encoding logged data into structured datasets. 3) Applying AI techniques to analyze encoded data and generate visualizations of expert workflows. 4) Knowledge recipients access visualizations to enable process comprehension and facilitate absorption of tacit knowledge in support of their decision making. 5) Continuous refinement of workflows through iterative analysis of user behaviors to reflect evolving best practices.

By leveraging AI to generate visualizations of logged expert workflows, this approach helps reconstruct knowledge networks for learners. In contrast to traditional methods, it aims to capture implicit knowledge as sharable contextualized workflows while maintaining the ability to address learning challenges. The workflow visualizations also support application of transferred knowledge and accumulation of new skills through decision making. Overall, this human-AI knowledge transfer framework enhances traditional methods by addressing limitations in transferring tacit knowledge and absorbing complex processes.

4.1 Experiment procedure

In this study, time series forecasting was selected as the demonstration task to integrate knowledge transfer and HACI. Currently, many forecasting tasks involve human-AI collaboration where AI plays an assisting role while humans are primary decision-makers. The goal is to achieve more accurate predictions using forecast accuracy as the evaluation metric. Domain knowledge will be incorporated through scenarios assuming individuals with relevant expertise can perform better.

The experiment involves preprocessing raw time series data by segmenting into predictive features. An initial GAM model will be trained and forecasts generated. Participants with domain/technical knowledge will review background materials and forecast results. They can iteratively adjust machine forecasts through an interface, applying knowledge to select adjustment factors, time periods, methods and intensities. Surveys will capture decision criteria after each adjustment cycle. Upon completion, an overall process feedback survey will also be collected. This aims to systematically evaluate benefits of combining machine learning with human judgment and expertise in knowledge transfer.

5 Evaluation Scenario of Current Research Method

5.1 Case study of electricity demand forecasting

This research uses electricity demand forecasting in Tokyo as a case to validate the proposed knowledge transfer approach. With complex real-world conditions, this prediction task integrates specialized domain knowledge and technical skills. The task requires participants to make prediction based on algorithmic prediction. All participants $(n = 9)$ comes from University of Tokyo with 6 of them have the technique background in Artificial Intelligence.

6 Preliminary of Results & Discussion

The self-designed user interface by Python logged all behaviors in detail throughout the entire prediction task, from start to finish. This enabled the collection of full behavioral log data as the participants executed the real-

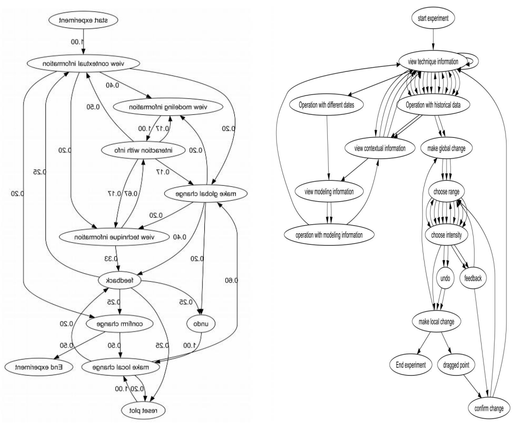

Fig. 2 Flowchart of participants workflow (2 Samples)

world forecasting workflow from their expertise. The AI backgrounds of participants ensured understanding of technical factors while their completion of the task incorporated specialized electricity domain knowledge.

This research visualized the expert's full forecasting workflow from the behavioral logs, reconstructing the decision process. Recipients often lack clarity on the required steps, sequencing, and motivations. Visualizing the logged workflows provides useful understanding of the overall forecasting process and individual steps, enhancing real-world decision support for inexperienced recipients. Leveraging complete data logs to visualize workflows improves process comprehension.

As shown in Figure 2, the workflows from two participants with technical knowledge were recorded from start to finish. Their decision rationale was also captured at key points. Notably, the two subjects exhibited very different workflows, owing to dissimilar mental models of the overall task. The varied workflows also reflect differences in applying tacit knowledge, which is challenging to accurately capture, especially remotely. Figure 3 shows another visualization supporting workflow understanding by mapping process steps chronologically. This not only depicts experts' decision flows but also reveals time spent. With both workflow and timing details, the

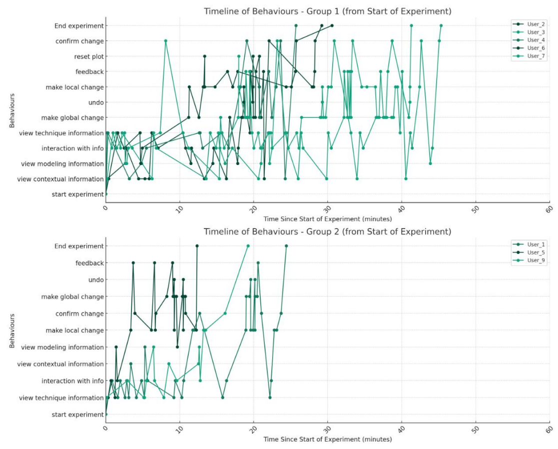

Fig. 3 Flowchart of participants workflow (2 Samples)

figure reflects the knowledge may have different representation when considering of the time, especially for expert user and non-expert users.

7 Conclusion

In conclusion, this study contributes an AI-enabled method to capture task-specific expert knowledge through behavioral logging and workflow analysis within a human-AI collaboration environment. The preliminary case study demonstrates the potential for HACI systems to log and contrast the decision-making processes of experts versus novices with and without technical backgrounds when time spent is considered.

Reference

1. Spitzer, P., Kühl, N., & Goutier, M. (2022). Training novices: the role of human-ai collaboration and knowledge transfer.. https://doi.org/10.48550/arxiv.2207.00497

2. A.Claudio Garavelli, Michele Gorgoglione; Barbara Scozzi (2002). Managing knowledge transfer by knowledge technologies. , 22(5), 0–279.