

Thesis Project Portfolio

CHESSBOARD: An Interactive Chess Learning Aid

(Technical Report)

International Collaboration in Research: Contrasting Motivations of Scientists and Funding Agencies

(STS Research Paper)

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Sociotechnical Synthesis

For my technical project, my Capstone group designed and manufactured the Chess Helper, Evaluator, and Study Supporter to Boost Observation, Acumen, Reasoning, and Deduction (CHESSBOARD). The CHESSBOARD is a smart chessboard focused on streamlining the chess learning process for a beginner to intermediate level of play. The prototype provides an intuitive way to learn chess through physical play. Light-emitting diodes (LEDs) underneath the chess tiles are used to communicate game state, available moves a player can make, and if requested, the best possible move. The CHESSBOARD also features a game clock that allows users to practice timed gameplay. After finishing a game, players can access a full transcription of the game for further studying.

The CHESSBOARD has two main modules: the game board and the clock box. The game board houses the LEDs, as well as the sensing and input/output printed circuit boards (PCBs). The sensing system utilizes Hall effect sensors underneath each tile for chess piece detection. Each chess piece (e.g. black pawn) is associated with a magnetic strength read by the sensors. The clock box module encases two embedded computers, the breakout PCB, and the user interface PCB. Game state validation is provided by the chess engine Stockfish that runs on the Raspberry Pi 5. The other computer is the MSPM0 microcontroller that communicates with each of the CHESSBOARD subsystems. The user interface PCB mounts the game clocks and buttons that players interact with.

International collaboration is a key component to modern science and technology, enabling groundbreaking discoveries in fields such as high-energy physics, climate science, and medicine. International research paves the way to revolutionary technology such as the Large Hadron Collider, Human Genome Project, and COVID-19 vaccine that benefit society. My STS

paper explores international collaboration through a social constructivist lens, highlighting the contrasting motivations of the scientists conducting the research and the funding agencies or governments supporting them. While individual researchers often pursue international collaboration for the sharing of intellect and resources, funding agencies are typically driven by national interests in global competitiveness and technological supremacy.

In my STS paper, I investigate the underlying motivations of scientists and funding agencies using qualitative and quantitative data such as surveys, citation rates, and funding trends. Because economic barriers remain a major hurdle to international research, the success of international projects are heavily dependent on the support of funding agencies. A Cold War-era case study of international collaboration between the United States and Soviet Union demonstrates how research initiatives were shaped by not only the pursuit of scientific knowledge, but political interests. Science and research are often viewed as the search for objective truth. However, by analyzing the motivations of the parties facilitating international research, I apply a social constructivist framework to demonstrate that science is not unbiased. By recognizing contrasts between the idea of pure, open science and the actual political biases introduced by funding allocation, we can improve upon these research networks to find benefit to all of society.

Both my technical and STS projects involve the sharing of knowledge across cultural, linguistic, and national boundaries. The CHESSBOARD is an intuitive learning tool that can be used regardless of age or language. The game of chess itself is played by people from diverse backgrounds. Professional players even travel from all over the world to compete in international chess tournaments such as the International Chess Federation World Championship. Much like

these tournaments, the CHESSBOARD allows anyone to engage with the game, no matter technical, cultural, and geopolitical barriers.

While chess tournaments foster environments for international competition, my STS research focuses on environments for international collaboration, particularly in scientific research. I explore international collaboration through a social constructivist lens to show how science and knowledge is influenced by the motivations of individuals scientists, as well as governments and funding agencies. These motivations are often based in competition, driving science in the direction of economic and political interest. These projects demonstrate international engagement – both competitive and collaborative. The game of chess is a competition of brilliant individuals, whereas scientific research fosters a collaboration of great minds. Both projects highlight the importance of transcending linguistic, cultural, and geopolitical differences in the pursuit of intellectual advancement.