Utilizing AI for Visual Weld Appraisal

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Introduction

The integration of Artificial Intelligence (AI) into secondary education has many potential benefits. AI has already been integrated into our daily lives and is constantly progressing. AI is already being used to enhance the educational experiences of students and improve the instructional quality of teachers. AI is already being utilized in school-based agricultural education classrooms and laboratories for content and lesson planning, image generation, assessment creation, and writing/ speech improvement (Pehrson et al., 2025).

The Agricultural Technology and Mechanical Systems program of study is a popular pathway for many students in the Agriculture, Food, and Natural Resources career cluster (Valdez & Johnson, 2020). As such, agricultural mechanics teachers have expressed a need for training in many content areas, including metalworking and welding (Wells et al., 2021).

One tool that may provide a useful solution for novice teachers with visual weld appraisal is AI. Visual weld inspection and research on non-destructive testing of welds is progressing and working towards ensuring precision and reliability in various industrial sectors, leading towards the increased use of AI in weld evaluation (Say et al., 2025). In [STATE], there is desire from public school administrators for an increasing number of Industry-Based certifications. Welding certifications have become on such certification option. Appropriate weld evaluation is a critical aspect of that instruction. AI may prove to be a useful tool in assisting new, and experienced teachers, in their visual weld appraisal.

Research into image interpretation and Large Language Models such as ChatGPT®, Google Gemini, Microsoft Co-Pilot, and Julius AI is steadily increasing. The progress being made in the area of interpreting real-world images, specifically in the welding domain, is notable and worth further investigation (Khvatskii et al., 2025).

How It Works

Students in the AGSC 1451 Introduction to Agriculture Mechanics course at Texas A&M University-Kinsville were assigned to complete an American Welding Society (AWS) 1.1 weld test using shielded metal arc welding. After completing the weld test, they were instructed to take a picture of the completed weld and run it through ChatGPT Pro®. The prompt students were to use was as follows: “Perform *a visual appraisal of the provided weld image describe any weld imperfection including porosity inclusion, undercut or lack of fusion. Then provide any recommendation on how to improve this weld*”.

To ensure accuracy and consistency for pictures, all weld images used the same camera, lighting and backdrop. We used a space in the classroom that included both LED and fluorescent lights and a white backdrop. Welds were than given to an in-person certified weld inspector (CWI) for visual weld appraisal. The CWI wrote evaluation comments for the students’ AWS 1.1 welds. These results were then compared to the ChatGPT responses. This included both weld appraisal and recommendations to improve the weld.

Results to Date

Students found that using ChatGPT Pro® provided a more detailed response, than using the free version of ChatGPT. The AI accurately identified key weld characteristics such as bead consistency and visible weld defects (porosity, slag inclusion, etc). These were validated by the CWI weld appraisal. One thing the AI could not perform effectively, but the CWI could, was measurements on the weld for appraisal. This included identifying if the weld met test requirement of a 5/16 weld face. In regards to recommendations, it was found that the AI provided more general tips for effective welding rather than specific directions for each weld. Examples included: **Amperage:** Increase slightly if penetration is shallow, but avoid overheating that causes undercut. **Travel Speed**: Maintain a steady pace—too fast causes poor fusion; too slow leads to excess buildup and porosity, **Arc Length:** Keep the arc close to the work (~1/8 inch for stick welding).

The CWI was able to provide guidance on welding technique rather than general recommendations ("Slow down at the end of your weld"). They also were able to pin-point exactly on the weld where the slag inclusion or porosity was found. Students agreed that the AI helped them to identify if the weld was satisfactory, but felt that the CWI provided better recommendations for future practice.

Future Plans/Advice to Others

These findings suggest that AI-generated feedback can support agricultural mechanics instruction by providing students with consistent and immediate evaluation. Integrating AI tools into welding programs can enhance learning outcomes, streamline assessment, and introduce students to digital tools shaping modern agricultural industries. This should not be used as an official certification testing tool, but can used by novice instructors to provide general visual weld appraisal. Teachers utilizing such tools should try a to use the same prompt for each weld. They need to have a set place for photos that provides enough light to minimize shadows and an effective backdrop.

Future studies will compare multiple AI platforms to determine which, if any, delivers the most precise and informative weld evaluations. Each system will use identical weld images and standardized prompts. Educators replicating this project should maintain consistent weld conditions, lighting, and image quality, and collaborate with a certified instructor for validation.

Costs

Materials included the ChatGPT Pro subscription ($24/month), camera ($500), ring lights ($80), welding equipment, time for instructor evaluation (donated). This project was supported by a USDA Higher Education Challenge Grant (2022-0430) and the USDA NextGen grant program.

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