Invited Contributions to STEM Education NON-REFEREED ARTICLE

A Case for Culture & the Arts in Engineering Curriculum as a Response to Advanced Artificial Intelligence

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Introduction

Recent growth in public awareness and the subsequent adoption of advanced artificial intelligence (AI) tools has been rapid and widespread. Almost every person and every field are affected by and can benefit from its presence, engineering being no exception. However, with any great advancement in technology come great challenges and the need to adapt. The capabilities of advanced AI (artificial intelligence comparable to or exceeding the human) are already making many engineering jobs and academic assignments obsolete. No longer will the traditional practice of engineering, focused largely on perfect calculations, be exceptional or competitive. No longer will a traditional engineering education be sufficient, if even possible to administer under the new AI paradigm. Instead, to compete in a world with advanced AI, students and professionals will need to rise above being a mere human calculator (HC): an engineer focused solely on perfect calculation, to becoming an advanced engineer (AE): an engineer that is able to leverage AI and integrate more human characteristics into engineering practice. However, much of engineering practice exclusively values objectivity to the detriment of human-centered considerations such as culture, the arts, beauty, and emotion, none of which are intrinsic to AI. Solely teaching engineering students tasks that AI can complete quickly and to perfection will not set a foundation to make a large and positive impact on the world. With this in mind, we turn our attention to the portion of higher education that deals with concepts beyond computation: culture (defined here as the customs, values, practices, and priorities of a particular people such as a nation or social group) and the arts (namely, the fine arts such as music, dance, painting, sculpting, etc.). Many studies show that including culture and the arts in engineering education improves an engineer's ability to both evaluate and create; a requirement from the Accreditation Board for Engineering and Technology (ABET, 2017). While studies have shown the benefit of intertwining culture and the arts and engineering education, the concept has yet to become widely valued, much less adopted as standard practice in engineering education (Campbell, Reible, Taraban, & Kim, 2020; Davis, Joshi, Czerwionka, Montalvo, & Rios-Rojas, 2021; Faulconer, Wood, & Griffith, 2020; Jablokow, 2007; Jacobsen, 2020; Josa & Aguado, 2021; Kim, Kim, Hyun, & Yoon, 2022; Lyman, 2001; Ryan, 2020; Salti et al., 2019). Altering engineering curriculum in any manner is no small feat, but there are practical and achievable ways to incorporate culture and the arts. Three methods we propose are as follows: 1) Include assignments in standard engineering courses that are based on cultural and artistic topics, 2) Modify currently required non-engineering core classes to connect more with technical fields, and 3) Include full courses in engineering curriculum that present engineering within a cultural and/or artistic setting. For example, at Auburn University, we have created and successfully implemented a course called *Engineering in the Arts,* which teaches various engineering concepts within a cultural and artistic context on site in Florence, Italy. Incorporating cultural and artistic context into engineering education will lay the foundation for students to become AEs with the ability to build upon the current and future greatness of AI systems. We contend that a cultural and artistic enhancement of engineering education is the best and most appropriate response to ubiquitous AI that threatens the role of the traditional engineer (Mrabet & Studholme, 2023; Rahman, 2023).

Background

The release of the impressively powerful 3.5 version of ChatGPT to the public by Open AI in November of 2022 (ChatGPT) can be identified as the singular event that introduced the world to the capabilities of advanced large language models (LLMs)[1]. ChatGPT-3.5 has been able to help real estate agents quickly write property descriptions for advertisements. It has helped corporate leaders draft meeting agendas. It has helped students understand inherently complicated concepts when they asked the model to provide an explanation in simple terms. It even helped lawyers to quickly comprehend dense and lengthy legal documents. The highly technical and complicated nature of advanced AI had given way to a useful tool for the population at large.

A review of the history of computing and AI itself can provide context to the progression of AI development to current day. Alan Turing's invention of the first computer, the Turing Machine, in 1936 marks the beginning of the computer age. Shortly thereafter, in 1955, the term *Artificial Intelligence* (AI) was coined by John McCarthy, et al. in their proposal to Dartmouth University titled, *A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence* (J. McCarthy, Minsky, Rochester, & Shannon, 2006). In this seminal work, the authors state that, "Every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it" (p.g. 1). They also discuss how, although computers at that time were limited in speed and capacity, the only thing preventing computers from performing higher functions of the brain was the human coder's inability to take full advantage of the tools available (p.g. 1). Over thirty years later, in 1987, the same John McCarthy, now considered one of the founding fathers of AI, wrote that, "No one knows how to make a general database of commonsense knowledge that could be used by any program that needed the knowledge" (p.g. 1) (John McCarthy, 1987). Six years after that, in 1993, the internet was released to the public. In 2022, nearly 30 years after the release of the internet, advanced AI systems, including LLMs such as ChatGPT, would be successfully built with highly complex analytical skills and by indeed using the internet as a "general database of commonsense knowledge," as was so presciently described by John McCarthy et al., in 1987. That same year (2022) Google's LaMDA (Google LaMDA) became the first AI model to win Alan Turing's *Imitation Game*, now known as the Turing Test: "A remote human interrogator, within a fixed time frame, must distinguish between a computer and a human subject based on their replies to various questions posed by the interrogator" (Britannica). One short year later, in 2023, AI is now so ubiquitous that it is difficult to find a field where AI has not already been incorporated.

Instead of a what might initially be perceived as solely a *competition* between the human and the machine, many authors are reporting on and advocating for the potential of advanced AI models to enhance the human's ability. Stolyarov II discusses his perceived hope that "the

[1] Large Language Models can be defined as interactive AI able to generate brand-new text based upon short input requests (Perkins, 2023).

continued advancement of musical software, algorithms, and AI will amplify human creativity..." (Stolyarov II, 2019). Biswas et al. mentions the use of AI in digital marketing as being "the most exciting and promising area for any organization in the current era..." (Biswas, Sanyal, & Mukherjee, 2023). Haleem et al. reference high-resolution weather prediction and medical image analysis capability of advanced AI models in their article titled "An era of ChatGPT as a significant futuristic support tool: A study on features, abilities, and challenges" (Haleem, Javaid, & Singh, 2022).

AI is not only able to be used by musical artists, marketing professionals, meteorologists, and radiologists. It is also being widely adopted in the field of education. There's a great deal of recent literature addressing the potential benefits of AI to education. Siegle et al. discuss the use of AI in gifted education as it is able to provide "Advanced content, personalized learning, creative writing and image manipulation, critical thinking, [etc.]" (Siegle, 2023). Su et al. points to the benefit of using ChatGPT as a peer with which the student can practice argumentation skills and receive meaningful feedback (Su, Lin, & Lai, 2023). Javaid et al. highlight the potential of ChatGPT to be used to automate test and assignment grading, allowing instructors to spend more time on actual instruction (Javaid, Haleem, Singh, Khan, & Khan, 2023). They also mention the potential benefit of using this model for language lessons as it can easily translate text from one language to another (Javaid et al., 2023). Rahman et al. explore and report on the ways that ChatGPT can be used to help students improve their programming skills (Rahman, 2023).

As beneficial as it may be, AI can negatively affect current educational methods as well. Some say that AI has become too helpful in education and allows students to avoid completing traditional educational assignments on their own. Practicing engineers and engineering students learned quickly in late 2022 that some of the newly released LLMs were able to generate software code (e.g., MATLAB or Python) based upon provided prompts (MATLAB; Python). Then the model could generate a technical report[2] based on the results of the code that it just ran. These capabilities, in particular, should blip the radar of anyone involved in engineering education, as the ability to write code is considered a cornerstone of an engineering education. This recursive, profound even, capability of advanced AI to write code along with its ability to write technical papers is likely perceived as an ally by engineering students but is equally as likely to be perceived as an enemy to the educator (i.e., the use of ChatGPT is *cheating*).

So begins the present dilemma: how should educators approach engineering education in a world where advanced AI can quickly complete tasks previously considered foundational to the education of an engineer? The current primary goal of an engineering education can be perceived [by some at least] as, in large part, to generate a flawless "human calculator" with the capabilities to solve problems via multiple methods such as the abstraction of a physical system into a solvable system of equations, or the design of a device or structure capable of meeting predetermined constraints, or the generation of computer code able to perform a certain task. To this end, the current educational initiative primarily involves the engineering student working numerically-based problems that are graded for accuracy, with a notable exception of design work, although this also often involves extensive calculations. Thus, the advancement of advanced AI tools, capable of doing most of these tasks perfectly, threatens the traditional approach to engineering education with, at the least, partial obsolescence.

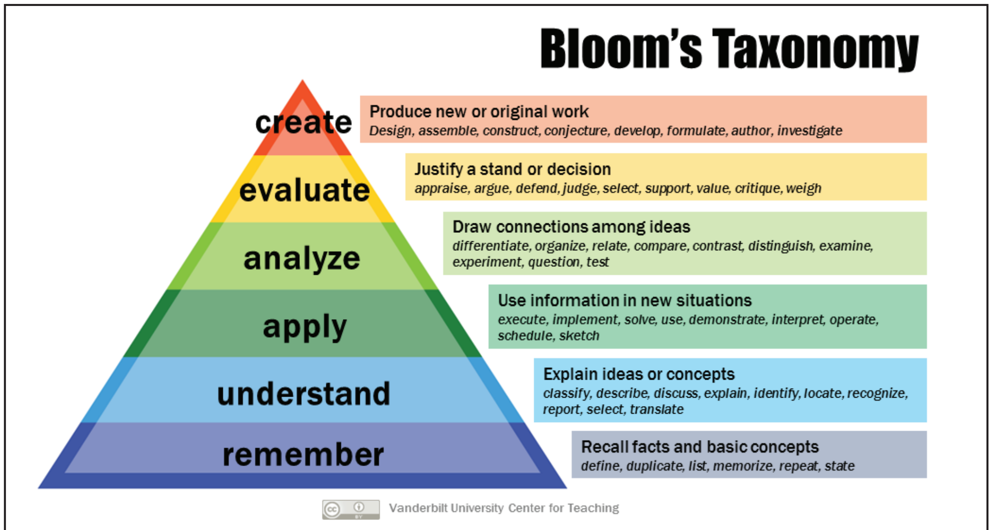

Figure 1. Bloom's Taxonomy. Image sourced from the Vanderbilt University Center for Teaching (Armstrong, 2010).

To understand where advanced AI may be able to assist in the educational process, and in turn where it may be limited, it is helpful to consider the *Taxonomy of Educational Objectives* also known as *Bloom's Taxonomy* (Bloom, 1956). The taxonomy was originally published in 1956 by Benjamin Bloom et al. as a means to establish a framework of educational goals (Armstrong, 2010) and later revised in a work titled *A Taxonomy for Teaching, Learning, and Assessment* (Anderson & Krathwohl, 2001). The 2001 revised categories of Bloom's Taxonomy are as follows: *Remember, Understand, Apply, Analyze, Evaluate* (justify or stand for a decision), and *Create* (produce new or original work) and are shown in Figure 1.

Most all education begins at the bottom of the hierarchy, *Remember,* such as remembering the equation for the polar moment of inertia of a cylinder. If current engineering education indeed stops at creating a flawless HC, then the student at best may elevate to the *Analyze* level of knowledge. However, the most ideal outcome of an engineer is an AE elevated to the top level: *Creator.* While this may require years of experience to attain, engineering education can prepare students for the highest level, rather than restraining or satisfying them at mere *Analysis.*

LLMs and other advanced AI can most certainly *Remember* as these models are created from the database of the internet which is full of facts. As the latest LLMs can pass Turing's *Imitation Game* (Google LaMDA), it can be reasonably concluded that the models can also fall into the *Understand* category as well. Although, it's not clear if a model truly understands or is just able to convince a human interrogator that it can. It can also be argued that these LLMs are able to *Apply* learned knowledge as they are built to provide answers to questions based upon their gathered knowledge base. Depending on definitions and interpretation, some might say that the models can even *Analyze*; for example, if it prepares a meeting agenda that follows a specific theme or combines thousands of product reviews into a single paragraph.

The last two categories, *Evaluate* and *Create*, do seem to go beyond the intrinsic ability of AI, even though they can feign these abilities by channeling the original programmers. Because the creator (i.e. programmer) of the model can set and decide opinions, ethics, and morals for the code, the AI itself is not the originator of any resulting evaluations (i.e. subjective opinions). Even in seemingly objective LLMs, unintentional biases and opinions from the programmers will undoubtedly make their way to the code output[3]. It could be reasoned that any subjective argument the AI proposes is processed through the morality or nature of the programmer(s). For example, in the journal, *Science and Engineering Ethics,* Rebecca Davnall presents the ethics of the response of an autonomous vehicle in the classic trolley dilemma, where

[2] Currently, most technical writing generated by LLMs require revision by the human to result in high quality writing. However, it is expected that as LLMs improve, this will become less and less needed.

[3] Unintentional biases and opinions of AI programmers necessitates an entire field of study on AI ethics (Wu, 2023).

Figure 2. Two paintings generated by NightCafe. Left was the result of the prompt "Undiscovered Painting by Leonardo Da Vinci." Right was the result of the prompt "Modern Art Painting with Sunset Colors."

a choice is to be made between keeping course allowing the *death* of multiple people or actively swerving and *murdering* a small number people but causing less death (Davnall, 2020). The discussion involves the intricacies of the various versions of this dilemma. Nonetheless, what naturally follows is that the vehicle will simply do what it is programmed to do. Should this scenario play out in reality, the result will be due to the *a priori* decisions of programmers and not the complex moral evaluation of the autonomous vehicle in real time. The ethical decision tree algorithm *(if* this *then* that) will have already been put in place by a human programmer, thus the evaluation and subsequent decision will have already been made.

The ability of advanced AI to *Create*, produce new or original work, is a controversial topic. First, there should be some agreement on the definition of the word "new" which can be taken in many ways. The two fighting perspectives of this definition, as related to AI, are 1) "Having recently come into existence," and 2) "Of dissimilar origin and usually of superior quality" (Merriam-Webster). The first can represented as a new baby; babies, of course, are not new, but each baby individually can be considered new and original as it did not exist before. The second can be represented by a new patent; each patent is checked for repetends and confirmed that it has never been specifically invented before. An example of this in AI can be seen in models such as NightCafe, an all-in-one art generating platform (NightCafe). Examples of NightCafe generated art are shown in Figure 2. Some might reasonably conclude that NightCafe creates art that recently came into existence; proving new art by Definition 1. Others might reasonably conclude that since NightCafe is only able to *Create* art based on a large database of provided human-generated art it is not creating, but merely generating an image based on various combinations of human-generated images, disproving new art by Definition 2. Concluding that AI generates new art contributes to the argument for AI being able to *Create* but is still only part of the definition of *Creation*, as the originality is lacking[4].

Determining the influence of the programmers towards the production of the work must be taken into consideration when considering AI's ability to *Evaluate* and *Create.* In doing so, the lack of agency, responsibility, imagination, and morality in an AI program become apparent. AI decisions cannot be separated from the will of the programmers; it can only mimic human interaction or human work output (Figure 2). Therefore, the original programmer can be given some credit for the contribution of subjective thought and subjective production. In addition, the prompter can be given credit for the creativity of the prompt itself. The combination of the programmer and the prompter is what results in the art production, not the spontaneous and creative nature of the program. Thusly, the AI program, such as NightCafe, can be considered a tool of creation, akin to Michelangelo's chisel or Da Vinci's paintbrush, albeit far more technically complex. Therefore, AI does have inherent limitations as it relates to *Evaluation* and *Creation*, as it is unable to truly accomplish either. It is within the realm of these very AI limitations where one can find human-specific concepts such as culture, art, beauty, morality and ethics. We contend that this is exactly where the engineer of the future must sit and thrive.

Culture and the Arts in an Engineering Education as a Response

We propose that the proper response of engineers to the rapid deployment of advanced AI within society is the adaptation of engineering education. We suggest the broadening of the scope of an engineering education to include non-traditional concepts and contexts. Subjects such as history and literature (culture) and fine arts are readily available on campus and can be easily accessed far beyond a few core classes to give the engineer a broader education. While these fields tend to be viewed as purely subjective, they do develop their own unique problem solving, critical thinking, creative thinking, and decision-making skills which may be useful to engineers (Evans, Lynch, & Lange, 2007; Lowe & Cook, 2003; Salti et al., 2019). Unfortunately for engineers, the reduction in exposure and perceived value of culture and the arts in engineering education has been increasing since the end of World War II (Dubreta, 2014; Ruprecht, 1997; Sjursen, 2007). The most common explanation for why this has occurred is that modern engineering education is so technically rigorous that there is now simply no room for inclusion of non-technical subjects (Sjursen, 2007). The highly valued logic and objectivism of technically rigorous work has resulted in non-technical endeavors, such as the humanities, to be commonly derided by engineers (Evans et al., 2007; Ruprecht, 1997; Sjursen, 2007). These areas of study are considered by many engineers to be "soft" or "easy" and even an unnecessary waste of time (Ruprecht, 1997). Because engineers choose to concern themselves with such isolated objectivity, culture and the arts have become seemingly irrelevant (Davis et al., 2021). This thought is taken so far that oftentimes engineers proudly qualify themselves as incompetent as it relates to these topics (Ruprecht, 1997).

Combining engineering with culture and the arts is not a new proposal; in fact, there has been a growing awareness of the deficiencies of engineers due to the lack of exposure to these topics in the last few decades (Knepler, 1973; Ruprecht, 1997; Sjursen, 2007). Moreover, studies consistently show that deliberately combining engineering with these topics in curriculum improves the engineer's skillset (Faulconer et al., 2020; Jablokow, 2007; Jacobsen, 2020; Josa & Aguado, 2021; Kim et al., 2022; Lyman, 2001; Ryan, 2020; Salti et al., 2019). However, this has yet to become a common practice or a strategic objective for universities (Davis et al., 2021). We believe that the deliberate incorporation of culture and the arts into an engineering education will not only ensure its relevance in a future with ubiquitous AI, but more importantly improve student outcomes beyond that of a reliable HC so that they can most effectively advance civilization and the human experience.

Practical Solutions

The practicality of incorporating more culture and art into an engineering curriculum can be challenging. Even those who agree that this would be good for engineers are overwhelmed by the task (Sjursen, 2007). Indeed, most engineering courses and degrees currently require mostly calculation rigor and the fear of weakening this rigor leads to a continuation of the status quo (Sjursen, 2007). However, culture and the arts can be incorporated into engi-

[4] It has been said that if one were to ask an LLM whether it would have the ability to write code if it were not initially fed human-generated code on which it was taught, the response might very well be, "Can you?".

neering degree programs without sacrificing the technical rigor of traditional engineering while gaining the advantages they have to offer. These changes are proposed here with the understanding that the student's technical expertise is not reduced but enhanced. Three methods we propose are as follows: 1) Include assignments in standard engineering courses that are based on cultural and artistic topics, 2) Modify currently required non-engineering core classes to connect more with technical fields, and 3) Include full courses in engineering curriculum that present engineering within a cultural and/or artistic setting. With these three options, universities and educators can move towards incorporating culture and the arts without abandoning the technical rigors of the degree.

Current engineering core and elective classes have room for culture and the arts to be included in the topic selection by way of assignment and project themes. Design courses, in particular, are well-positioned to make these incorporations. For example, Wuerffel and Will describe an effort in a design course at Valparaiso University that partners engineering and art faculty to create and support design projects for mechanical, electrical, and computer engineering students in the fields of art, music, dance, and theater (Wuerffel & Will, 2015). By merely including researchers from the humanities and UX/technical communication in curriculum design and creation, Jacobsen shows a measurable positive impact on student performance in their ability to write mathematical arguments (Jacobsen, 2020). In an experimental interdisciplinary course, Texas Tech University has been working on a project called *Developing Reflective Engineers through Artful Methods* (DREAM), funded by the National Science Foundation (NSF), to provide a more holistic education, with culture and art topics and methods (Campbell et al., 2020). A study of this project found a statistically significant improvement in insight, contextual competence, reflective skepticism, and interdisciplinary skills – all which contribute to an AE's development (Campbell et al., 2020).

For non-design-based courses, the inclusion of cultural and artistic context is possible as well. For example, a mechanical engineering student can analyze the shear forces and impact angle effects for various chisels on the removal of marble during sculpting. Instead of a student studying the dynamics of an unrelatable, generic four-bar linkage, the student can analyze the biomechanics of a ballerina performing a fouetté turn. Proper and technically accurate artistic perspective can also be taught and required for work done on three-dimensional technical problems. The relatively simple modifications such as the ones above will expand students' minds and will ultimately improve the entirety of their technical education (Jacobsen, 2020; Sjursen, 2007; Wuerffel & Will, 2015).

Core courses outside of the engineering major, specifically some humanities courses, already add to the engineering students' exposure to culture and the arts. It's widely accepted that the purpose of these non-technical

Figure 3. ***Engineering in the Arts*** **students with Michelangelo's** ***David*** **(left) housed in the Accademia Museum and Leonardo da Vinci's painted angel in** ***The Baptism of Christ*** **(right) housed in the Uffizi Gallery, both in Florence, Italy. Engineering lectures that precede these visits are "Sculpture and Michelangelo" and "The Science of Painting and Drawing", respectively.**

courses is to develop well-rounded students. However, the current disconnect between these courses and their benefits to engineers preemptively discourage students from approaching the class with any meaningful appreciation. As a result, the skills and enrichment offered by these courses are lost on the students. This is disappointing as the benefits from exposure to culture and the arts are quite evident. Sjursen even proposed to create a formal intellectual alliance between humanists and engineers to "foster the reflective discourse needed to impute humanistic concerns into the problem-solving strategies for engineers" (Sjursen, 2007).

It is possible for some core courses to be offered with a STEM focus. Even now, some students are able to choose unique history courses at Auburn University that connect their interests, such as the *The Automobile in History*, by Dr. David Lucsko, or *Technology and Civilization*. These types of courses can be promoted to serve as a clear connection between engineering and culture and/or the arts. Other courses can have slight modifications made to incorporate a connection between the fields. These might be to include assignments that develop the engineering design process. For example, an assignment that breaks down the structural analysis of a building from an architectural perspective, or a detailed stage design within a theater course. These types of assignments would help engineering students see how culture and the arts are not devoid of engineering concepts, but, in fact, have them deeply integrated. Incorporating components of engineering in required core courses is the opposite of bringing the humanities into engineering courses as previously proposed; by doing so, all engineering courses, major and core, can contribute to the students' understanding of culture and the arts within engineering.

Lastly, entirely new engineering courses can be offered that incorporate culture and the arts deliberately and more deeply than merely adjusting currently required courses. In these courses every topic and assignment can simultaneously develop engineering techniques alongside culture and the arts. Some courses such as these already exist at select schools, such as the *Biochemical Engineering of Wine* at the University of Pennsylvania, *Concepts of Chemical Engineering: The Design of Coffee* (by Dr. Steve Duke) at Auburn University, *Silversmithing and Design* at Stanford University, and *Introduction to Cross-Cultural Communication for Engineers at Pennsylvania State University* (Biochemical Engineering of Wine; Concepts of Chemical Engineering: The Design of Coffee; Introduction to Cross-Cultural Communication for Engineers; Silversmithing and Design). The University of Michigan even has a center for engineering and the arts, called the ArtsEngine (ArtsEngine), and Carnegie-Mellon has gone as far as to make a Bachelor of Engineering Studies and Art degree (Bachelor of Engineering Studies and Art). While these courses and degrees are an encouraging shift towards culture and the arts, there remain only a small number of universities who have adopted such approaches.

At Auburn University, we have created an entire course dedicated to the effort to combine culture, the arts, and engineering. The course, titled *Engineering in the Arts*, is offered as a three-credit hour technical elective for all engineering majors within the Samuel Ginn College of Engineering. The course also serves as the foundation of a four-week study abroad experience set in Florence, Italy, the birthplace of the Renaissance. The stated objectives of the course are to 1) Enhance the student's creativity, inventiveness, and ingenuity by providing a deep understanding and appreciation of the engineering associated with multiple artforms, and 2) Provide an understanding of the influence of the Renaissance, including key historical figures, on modern-day science and engineering. Examples of the lecture topics are *Leonardo da Vinci, Sculpture and Michelangelo, The Engineering of Musical Instruments,* and *The Biomechanics of Ballet*. Lectures are given in the morning and paired with afternoon excursions relevant to that day's lecture topic (Figure 3). For example, a morning lecture on the *Acoustics and Vibrations of Singing* will be paired with an evening at the opera. A lecture on *Architecture and Biomimicry* will include an afternoon tour of Santa Maria del Fiore (Il Duomo) and a hike to the top of the dome. The local (Auburn, AL) version of the technical elective, which is given the same name as the study abroad course, gives many of the same lectures and replaces the excursions with assignments, design projects, and a final lengthy presentation on the technical aspects of a fine art.

The inclusion of culture and the arts into engineering coursework must be supported by faculty and administration at all levels. The faculty must be supportive enough to take an active role in incorporating these elements into their respective courses, and the administration (department chairs, deans, and provosts) must support these efforts as they are likely to be concerned with continued accreditation. ABET accreditation for an engineering program requires a program to meet 11 criteria for student outcomes (ABET, 2017). Unsurprisingly, these include "an ability to apply knowledge of mathematics, science, and engineering" and "an ability to identify, formulate, and solve engineering problems." What may come as a surprise to those following the HC format of engineering education is it also includes "an ability to design a system, component, or process to meet desired needs within realistic constraints such as. . .*social, political, ethical* . . . [and] the broad education necessary to understand the impact of engineering solutions in a *global, economic, environmental,* and *societal context*." These requirements are beyond the intrinsic ability of AI. It can be reasonably concluded that the inclusion of culture and the arts into engineering courses will directly contribute towards ABET accreditation.

Conclusion

The advent and recent widespread public adoption of advanced AI, in particular LLMs such as ChatGPT, have created a unique challenge for educators. Moreover, due to capabilities such as advanced computing, code generation, and technical writing, it is threatening the traditionally foundational components of an engineering education with obsolescence. It is nearly impossible to extrapolate out to determine future capabilities of these systems, but to understand the role and current capabilities of AI compared to the human person we presented Bloom's Taxonomy (Figure 1), which is composed of levels from *Remember, to Understand, Apply, Analyze, Evaluate* and *Create*. Engineers who have developed to the most advanced degree are able to achieve all six levels of skill while AI, restricted by a lack of autonomy and agency, is not able to *Evaluate* or *Create* on its own without the will of the programmer and/or user. Soon, AI may sit at the very top of Bloom's Taxonomy, as far as we can tell (see the Turing Test). However, these systems will always remain non-human and, therefore, do have limitations. These limitations of AI are where engineers can and should operate in order to remain relevant in a world engrained with AI. Starting during higher education, engineers should aim for the highest level of learning: to *Create*. As such, the traditional focus of higher education, to create what we've termed Human Calculators (HCs), should adapt to develop instead what we've termed Advanced Engineers (AEs) by embracing AI and elevating the importance of their humanity, namely through the integration of culture and the arts into the curriculum. We do not suggest to abandon the educational goal of perfectly accurate calculations, as they are paramount to good engineering. We also do not suggest to remove or replace traditional foci of engineering education such as bridges, machines, and other devices. We do propose to augment and elevate engineering education by including elements of culture and the arts to ultimately create AEs. This integration of culture and the arts into engineering curriculum can be done on a small scale: including culture and art topic assignments and projects in currently offered engineering courses or including technical context in non-engineering courses, and on a larger scale: entirely new courses that address engineering, culture, and the arts simultaneously, such as the course we've created at Auburn University, *Engineering in the Arts.* We recognize that major changes such as these will require both faculty- and administration-level support; not only have studies shown just how impactful the inclusion of these topics are to engineering students' learning (Campbell et al., 2020; Davis et al., 2021; Dubreta, 2014; Faulconer et al., 2020; Jablokow, 2007; Jacobsen, 2020; Josa & Aguado, 2021; Kim et al., 2022; Lyman, 2001; Ruprecht, 1997; Ryan, 2020; Salti et al., 2019; Sjursen, 2007), but our research has indicated that inclusion of these non-technical topics in engineering courses can help contribute directly towards accreditation. Ultimately, inclusion of human-specific components such as culture and the arts in higher engineering education will ensure engineers are able to maximize their impact on an AI-infused world. We contend that in a society soon to be overwhelmed with machine-based computational capabilities, engineers should turn our gaze inward to what makes us exceptionally great: our humanity.

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