International Association of Societies of Design Research Congress 2023
LIFE-CHANGING DESIGN
Politecnico di Milano
9-13 October 2023

A production pipeline for an AI-powered design course

Derksen, Gerry

Clemson University, Clemson, USA.
gderkse@clemson.edu

doi.org/10.21606/iasdr.2023.284

We are entering a period of disruption in design which is up ending the process and in turn changing design education. By extension, the practice and profession will also be changed because of artificial intelligent (AI) tools which use machine learning (ML) technology. Current commercial versions of AI tools have already produced novel results sending a signal to design educators to consider the implications and future of design teaching. This paper introduces a new course being developed at our University in Graphic Communications to develop a pipeline which uses only online AI content generators to produce designs based on a process divided into seven segments of production. The stages are organized using general characteristics of thought, distillation, generation, integration, refinement, analysis, and evaluation. The pipeline will be discussed, used and modified by students who will work through three projects to produce materials that guide decisions, critique prototypes and collect data from user feedback. Generally, content will be created using current AI tools based on concepts and prompts thoroughly discussed and refined for the pipeline. The course is intended to initiate the discussion around a technology that has potential to radically change the way design is practiced in the near future.

Keywords: machine learning; design; education; process; pipeline

1 Introduction

Machine learning has become a clear front runner for most exciting technology of the past decade. Its commercial and popular use has grown particularly in the last year and looks to expand into many industries so much that discussions of job loss or replacement is a serious topic. Visual communication design is not immune to this technological change in an effort to make it more efficient and provide tools that will drastically change the practice of visual communication design. This paper describes a new undergraduate course in design that uses several machine learning tools to reimagine the design pipeline, creating original compositions using content generated from machine learning. The course is aimed at third year undergraduate students familiar with typical design processes but have not worked professionally. Discussion concerning the course content, goals and objectives of design projects are included along with other items on the syllabus.

We can only imagine what future processes and design skills will be needed in the practice of design. However, this course sets out a framework for changes using these techniques albeit integrated into a more formal structure and likely end up in one or two software platforms. A positive perspective of the changes envisions a designer's roles becoming even more focused on thought processes with less emphasis on technical skill however, more cynically, visual designers we educate today will need to update their skills if they are to remain relevant.

"We are going to see tremendous occupational shifts. Some jobs will climb while others decline. So how do we enable and support workers as they transition from occupation to occupation?"

James Manyika, McKinsey & Company, 2022

2 Design and ML technology

Over the past year we have seen several new commercial products that use machine learning come into the public domain. Each of them bringing surprising leaps forward in the results they can produce and, on closer inspection, clarify directions for improvement. The most popular of these products is Chat GPT from Open AI (2023) a large language model (LLM) that provides comprehendible unique paragraphs written by machine learning algorithms from simple prompts. Also from Open AI is Dall-E, an image generator which provides variations of images from text prompts or images provided to the machine learning software. Unlike the text generator Dall-E generates imagery that accurately depicts the object, people or places based on the prompt. It also provides variations at a rate of 50 images per minute and as of this writing, at no cost. Other versions of the software like midjourney and synthesia offer variations that are as impressive and novel to clients as any reveal from design professionals. What is consistent in discussion surrounding the generation of images is the ideas that are formed in the prompt and content examples provided to the software.

Design technologies have changed before. Over the last 40 years with the advent of computers and its instigation of printing processes that spurred direct to print, output was made accessible, efficient and affordable shifting design practice. (Kwan et. al., 2020) As a result, classrooms changed from traditional studio print shops to computer labs and teaching software was at least in part, added to program curriculum. Software has become so ubiquitous that online tutorials and how-to videos took the place of in classroom demonstrations which allowed professors the opportunity to return to teaching design thinking as a process to generate ideas and analyse solutions that were appropriate for the client and in context of design projects. The response to this change has been mixed; either a return to traditional methods as a kind of retreat to comfortable ambiguity that makes designers magical and mysterious. Or an embrace of the technology so exuberant that producing super users of software was motivated by students who entered design programs and were encouraged by design educators who struggle to keep up with anything other than changes in an ever-growing suite of applications. This same suite has started to include machine learning in an image generator (Adobe Firefiy, beta 2023) and likely include font generation as well.

Design education is again entering a paradigm shift that will change what, and by necessity the way in which design is taught. From an optimistic perspective designers will be more like directors making requests rather than memorizing software procedures and manipulations to create what is in our minds. Prompting a content generator to produce results also requires an understanding of history,

semiotics, creativity and some technical qualities as well as a sense of ML and how it works. It also frees designers to follow a line of inquiry currently prohibitive due to cost and time constraints. All the while ML generators can be given many tasks to produce multiple versions with even more subtle variations on the solution.

2.1 Current image generation processing

Many machine learning tools ask users to simply type a prompt into a text field but almost immediately we have an urge to make changes to the results and that process this is less clear. According to Linus Ekenstam (2023) the online tool, Stable Diffusion is easier to produce consistent images around a subject. However, the process he describes using MidJourney, another image generator, does provide relatively subject consistent images https://linusekenstam.substack.com/p/tutorial-how-to-create-consistent (as of 03/20/2023). More importantly is the use of terms and source material as well as the evolution of his prompts that provides the results. Ekenstam notes that he is not training the ML model, this is already done however learning continues to some degree with every new prompt, "you can hint at something you want or a style, and Midjourney uses that as inspiration when generating the output." To begin the process an illustration tool that provides different angles of faces is used as a guide.

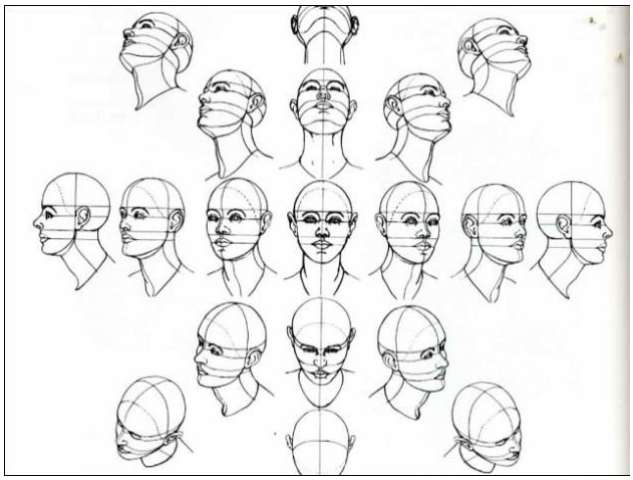

Figure 1. Illustrated angles of head for use in midjourney

We can imagine using other prompts such as this for animals or Muybridge's 1880's stills which provide profile views of humans and animals in different stages of motion (Muybridge, 2012). In this example a portrait of a woman in an urban setting (street style), side view is included in the prompt. Ekenstam's prompt also includes another interesting detail of the camera film type so that Midjourney produces qualities when using Kodak Gold 200 film. Immediately we should see how this information in the prompt and other references to Muybridge requires a knowledge of history and technical information that comes with experience. Providing this experience to students is critical in generating imagery as well as other content for a design layout that communicates a specific message. What is unique to ML is the original nature of the images and scenes being composed. Midjourney does use data scraped from the internet to train the neural network however does not use entire or portions of images to create the output. Using parameters, the model makes predictions that are mapped and weighted from the prompt description based on what is being queried (Mahesh, 2018). The results are new images interpreted from the prompt skirting the issue of copyright but raises questions about contribution to the training data set (McIlroy-Young, 2022). Ethics and inherent bias in the training of models will also be discussed in the course as well as considerations to mitigate these effects.

3 The proposed course

3.1 Change in focus

One strategy for developing a new course is to reverse engineer it, taking the expected outcomes from the class and breaking that down into digestible / teachable sections, followed by project level development that supports these sections. Once project ideas are developed determine the processes and methods that are needed to guide students toward the key learning objectives of each project. (figure 2) Support these with rubrics that reward the objectives or separate them into exercises for students to concentrate on and digest information in smaller chunks. For this course, the student is cast as design director creating design briefs and conceptualize the project direction, followed by developing a process pipeline that uses machine learning products for productions. Student concept generation may be client initiated but will keep user interests and experiences as well as contexts at the forefront.

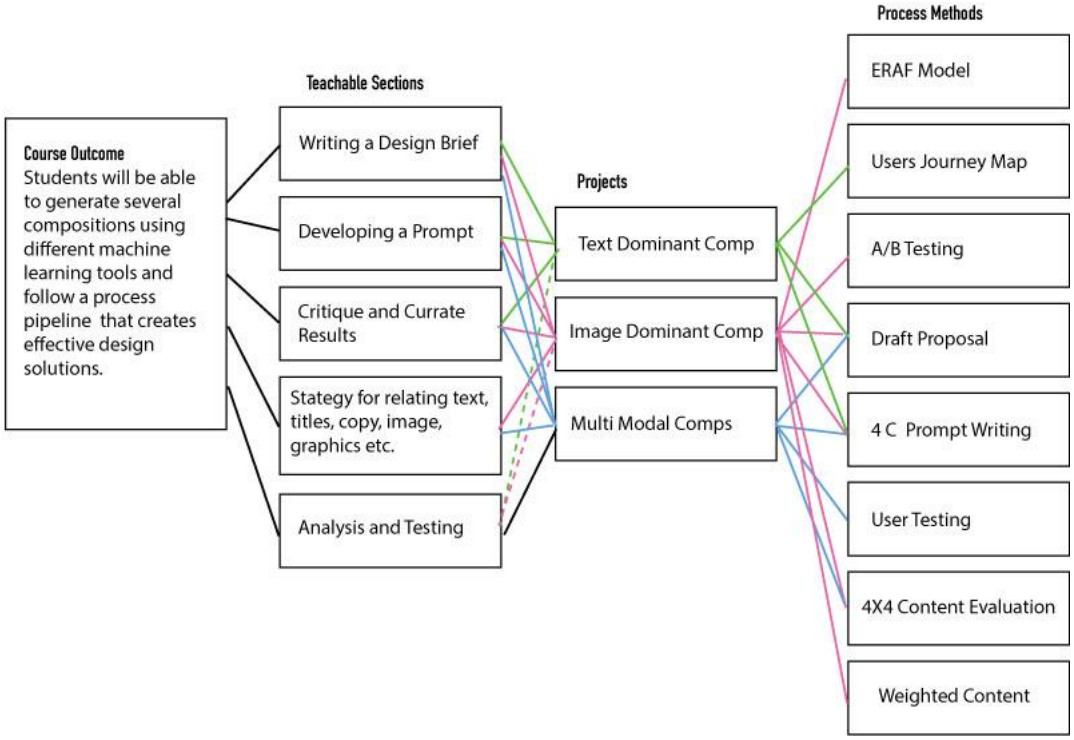

Figure 2. Course outline relationship

3.2 A new pipeline

For design researchers machine learning offers new arenas to be studied which tap into our current expertise as advocates for users because we are empathetic to their needs and understand how data can misrepresent the intended audience. We can no longer take a fixed position on designing an experience but rather see we can shape the parameters for users to operate within an open-ended system. It is a role for design researchers in the development stages of the tools and require a deeper knowledge of ML, regression models, and statistics.

For design practitioners machine learning tools will shift our focus toward the thinking end of the process and become more adept at describing experiences we want to create rather than crafting every detail. The current work pipeline begins with a brief defining the problem with an audience

description and data to provide some insight on their desires and beliefs. Concepts are developed through brainstorming and sketching among other techniques. From there a series of decisions are made to determine a direction for a client proposal that are manifest in some higher-level prototype or mock-up. At least for production designers the manifestations get changed, altered and refined over a period until approvals, followed by final versions that are sent to a printer or churned out into functioning web pages. What is most notable of the current process is the predetermined expectations for the outcome and experience early on that are then fixed within a narrow set of constraints. For example, themes, formats, standards become default choices rather than considered ones. This course encourages the perspective of many solutions based on the thoughts and decisions made early in the process and evaluated to determine what functions or achieves the best possible outcome or at least a considered outcome.

The ever-changing landscape of tools dictates an emergent pipeline however this course will follow a process of thought – distillation – generation – integration – refinement – analysis – evaluation with a compressed timeline during the content generation process. The following are segments of the process that form the work pipeline along with a description of each segment.

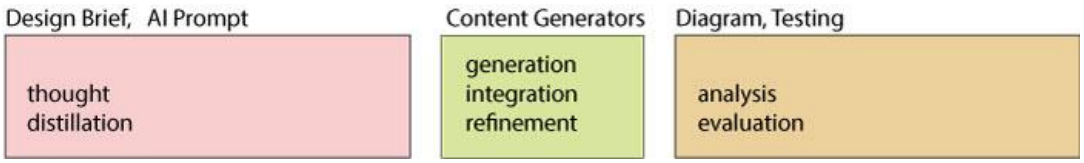

Diagram 1 Segment break down to process with content tools and/or deliverables

Each student will create three projects using the pipeline. The process is made of three segments and for each segment students will produce written descriptions, prototypes, diagrams and reports. Formal critiques for each project as well as discussions around strategies and techniques for using the generators will be evaluated as part of the course.

4 The Process

4.1 Thought

4.1.1 Design brief

Industry marketing departments develop plans which in turn inspire a design brief, that typically include a description of the audience listing demographic details, a description of the perceived problem, suggested stylistic or aesthetic qualities, who the competition is, timetable, budget and deliverables of the project (Smith et. al., 2008). Designers will want to have more input or even take on the responsibility of writing the brief to better understand the intended direction of the project. In consultation with the professor who will operate as the client, and with consideration of marketing, a review of the project's intent will challenge any preconceived outcome. The brief becomes the basis for the prompts to be used in creating content encouraging a closer connection between designer, client and marketing.

4.1.2 User definition, motivation, values

There are a number of design processes available to a greater or lesser degree of valuable outcomes for students. Stanford's d.school process, Neilson and Norman Group and others however, in this course the focus on methods is important to our particular program to deliver formalized methods

that students have not been exposed to at this point in their curriculum. Using VJ. Kumars text 101 design methods and the accompanying design innovation process we implement methods from the stages that define the user. The second and third stage of the process are 'know the context' and 'know the people' which function well at developing an understanding for the user and the scenario in which the design operates. Any number of methods proposed in these stages will be used in the course but most importantly the users are understood in terms of their own motivations and values but also in context of their culture, social norms and history in order to write more specific prompts and develop more relevant ideas.

Engagement is the result of a motivated user and without it learning becomes difficult. From a design perspective motivating people to change behavior is often what motivates design. Advertisements are developed to exploit motivation through, inclusion, sensations and feelings, competition, and narrative that encourage observers to participate and elicit the promise of an experiences (Lazzaro 2004; Sherry et al. 2006). Psychologist BJ. Fogg describe motivation in relation to ability which can fluctuate based on the value a user places on the benefit of continuing with an interaction. If the perceived value of AI is high the motivation to engage increases (Fogg, 2009). In this course an emphasis on values that an audience holds will be formally addressed using Hierarchy of Effects (see HOE diagram 1) model from the Journal of Advertising, winter 2008.

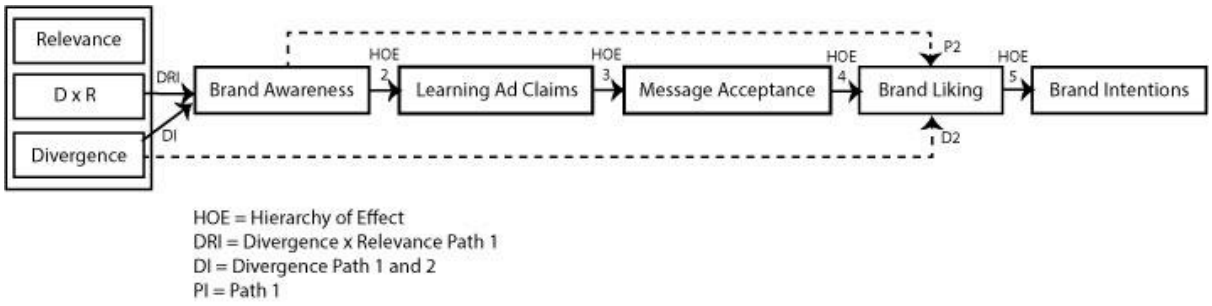

Diagram 2. Hierarchy of Effect Brand Communications Model Smith et al. (2008)

In the HOE model the term relevance is used to describe the connections a viewer has to an advertisement or brand for example. This is useful to the point of making an early connection or providing a point of interest, but it is what Van Veen, et al. (2021) define as weak signals in terms of pairing values of the viewer with the product being advertised "A perception of strategic phenomena detected in the environment or created during interpretation that are distant to the perceiver's frame of reference" (Van Veen, et al., 2021). In this case the strategic phenomena are the values being communicated which need to map to the values of the perceiver. For this reason, a list of values acquired through survey data will be collected by students and compared to relevance of the AI results. This should provide a more robust model beyond the temporal notion of novelty to communicate a relevant connection between prompt and user response.

The second input component of the HOE model is divergence referring to the extent to which an ad contains elements that are novel, different, or unusual (Smith and Yang 2004). Divergence here is defined as deviation from the norm or typical content. As a desired element of visual advertisements, communications have long history and extensive body of research into novelty and creative qualities that are outside the cultural lexicon of ideas. The tendency of AI users is to be captivated by the novel

effect and not to evaluate it for the message and impact on the intended audience. It may be novel to them as well but does not hold the values they desire for acting on the message.

4.1.3 Concept development

Once students understand the subject, context and the people who are involved they will generate any number of ideas using lateral thinking, user observations, product comparisons or other techniques to frame the problem. A problem statement will be written to synthesize thoughts and pinpoint the issues the student is attempting to solve. Using this problem statement, a prompt will be written to begin the process of using the machine learning tools. Machine learning uses prompts to direct the output, and this can be done in an exploratory way. Concepts can also be visualized using specific criteria which narrows results early limiting the possibilities and at this stage are less effective and do not take advantage of AI.

4.2 Distillation

4.2.1 Prompt writing

In the course, a work pipeline starts with any one of the generators listed above depending on the concept written into the brief. Depending on the stage of the process the prompts can be broader encouraging divergent thinking or more focused using criteria within a framework as follows: a subject, a context, adjectives that describe design characteristics, and technical input for detailed qualities. Concept inclusion into the prompt will depend on important features for each generator. For example, if a text dominant poster is likely to inform the audience a text generator may be a better starting point, or a font generator to emphasize the message being delivered. Conversely, an image generator could be used for an image dominant composition to draw in the audience. Using the same prompt as these starting points produces results that reveal the generators intent and own bias toward certain style qualities. (See figure 3). The results from the text generator and image generator suggest a particular stylistic quality that is not part of the prompt. The-same-prompt approach generates many variations on a concept as a type of brute force. It is the laziest of approaches and assumes a single mindedness about all ML tools which will likely reap little reward. A second configuration of the pipeline uses a refined variation of the prompt in a type of telephone game scenario. ML tools have the ability to remember the last prompt and refined prompts feel more like a conversation. Like the telephone game the outcome is very different from the initial concept of the design which places value on the designer to curate the results to guide the next iteration. This strategy also doesn't limit the prompt generation stage at any point in the pipeline. The subject and context of the prompt are descriptions that should be easily defined such as 'Asian male wearing a leather jacket in an urban cityscape, at dusk with mist in the air' (figure 3). This works well for an image generator but clumsy in a font generator and nearly useless in a text generator. Framing the prompt that is useful to all generators requires descriptors that start from the text generators modified slightly for the image and font generators to support the text voice, tone and overall message. For concepts that use metaphor, contrast, lifestyle or other abstract ideas this strategy falls short. It should be used to directly support the message in a literal format which is a less cleverly delivery but effective because of its clarity.

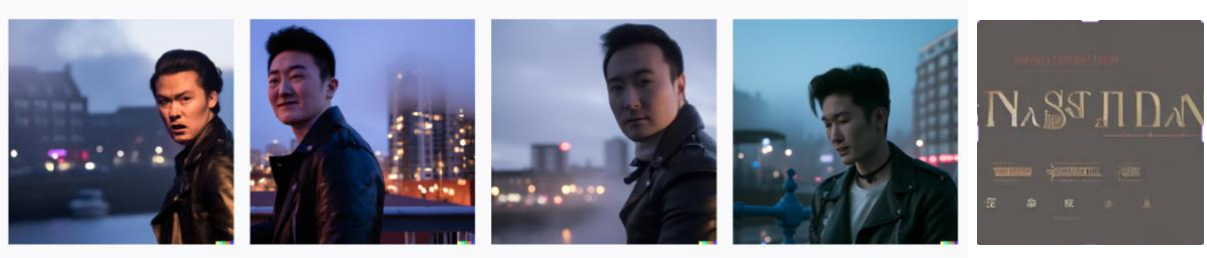

Figure 3 Four images generated by Dall-e 2 and font generated by PicArt (right) using the same prompt, "Asian male wearing a leather jacket in an urban cityscape, at dusk with mist in the air"

Using an exploratory method students will write prompts that may be simplified and more direct but return a broader range of results than the more direct approach using the criteria. In this way more iterations are needed to refine the results but similar to prototyping can produce new perspectives on a concept that is more loosely formed. A difficulty with this strategy is the potential for endless attempts at generating a new idea hoping for an interesting outcome. Without a clear idea and well-articulated brief, the results are novel to design students rather than address the problem. The benefit to this strategy is looking at the problem from many more perspectives than a design student typically will attempt. The resulting perspectives can be ingested as part of the prompt in successive attempts, provided the student is open to exploration and flexibility of project constraints.

4.3 Content generation

Each element of the design layout can be used as a prototype to be discretely evaluated for its contribution to the overall design. It will require students to think more deeply about the component parts and how their assembly builds to a more appropriate solution. The emphasis is on evaluation and because the production is faster to iterate variations of concepts as well as visual qualities a greater emphasis can be placed on the students thought process and criteria for conceptual development.

4.3.1 Image generators

There are a number of image generators online starting with Dall-e from Open AI. Using written prompts or a link to an online image included in the prompt, by default it will generate 5 variations of copyright free images. These can be modified using follow up prompts or increase the number of output images for more variety. An early criticism of many generators is the ability to manipulate the results using the AI tool. To change characteristics or elements in the image adding to the prompt with framing, lighting, or adjectives that are more descriptive will generate a desired outcome because most generators remember the previous prompt within a search session. More recent software such as MidJourney and Synthesia allow for more nuanced prompts such as camera film and subtly of tone that can produce more targeted results. The first project in the course, an image dominant prototype will be developed using design brief results and prompt writing to demonstrate ideation with refining terminology to get better results.

4.3.2 Font generators

Developing text dominant layouts is common practice for design schools and this pipeline will introduce students to the many approaches to consider visual communication materials. As part of the thought process discussions of when text should be used as a communication focus will be determined when the context of the problem is discussed in the process. Font generators in this

project can be developed in two ways; either with pairings from existing fonts that have characteristics described in the brief and prompt development stage, or to develop a new font using prompt descriptions. Fontjoy and MixFont are two software that combine the characteristics of two or more fonts and parameters can adjust the amount of 'influence' one font has on the final result. PicsArt is a generator that uses prompts to generate a unique font that is based on a large data set of fonts that the AI is trained on. Typical file formats for the font such as ttf and otf can be downloaded but in the case of PIcsArt the results are in bitmap formats that need to be converted to vector letter forms. Body copy from a large latent text generator like Chat GPT or more specifically trained software like ToolBaz for business copy or Zyro for brand text.

4.3.3 Graphics and layout generators

There are fewer layout tools available online however the ones that exist as of this writing provide the basic functions needed for this course. We can expect more of them to become available to designers and non-designers alike as tools come online. Designs.ai is a tool that creates layouts using self-generated content which will be provided by other AI's in the pipeline. Using these results as well as generators within the tool, graphic elements are created as well as a logo generator. Keeping in mind this tool is unlike other layout tools such as Canva which have pre-packaged layouts (templates) for users to select from. There are some AI features in Canva to help select colour palettes and resize content but not in the way that image generators create new content from a written prompt or predictive calculations. The generator uses descriptions of the type of layout and audience being targeted and creates original layouts with the original content supplied by the generators the student use. Similar to template platforms additional formats using the visual language of the designs will be generated for the second and third projects.

4.4 Integration

4.4.1 Implications for the Double Diamond

The convergent / divergent model has evolved through Alex Osborn (1953), Béla H. Bánáthy (1987), and later Nigel Cross & Roosenburg (1992) to how it is used today as a design process. The greatest change that AI tools bring to the design process comes from the sheer volume of material that can be generated. This is not just limited to the divergent halves of the double diamond model but through determined selection the convergence is also affected. Teaching students the use of AI tools increases the exploration in the ideation stage and using some AI refinement tools isolate a solution yet still produce multiple variations with subtle changes. In a classroom setting there is little time to get students to try many variations and explore ideas limiting their attempts to quick sketches that are often eliminated too soon to be given even partial consideration. Carrying an idea to a high-fidelity prototype can be done more quickly and therefore into a workable or even testable solution. Even the notion of sketch changes using these tools what would have been deemed a 'finished' mock-up is just a starting point.

4.5 Refinement

4.5.1 Curation – quality in, quality out

Many AI tools use imagery to seed the machine learning model placing an emphasis on the importance of selecting quality images. The best representation of a character is dependent on descriptions of these qualities and provide additional reference images such as lighting maps or a 3-dimensional model to set up a photo for a composition. Curation of these seed images is the equivalent to writing

prompts or to support written prompts to instigate the process. Teaching students to assess images for their communicative qualities is part of the course and this stage of the process. A formal process of defining the criteria for selecting the seed images corresponds to the adjectives and description of the output.

A short list of criteria is needed to converge broad concepts and narrow curation to determine what best communicates the message, concept or intent of the design. Emphasis on critique that includes knowledge of semantics and history as well as formal composition rules elevates their importance. Because ML can generate so many compositions students can exercise their curatorial skills relative to the design brief and concept statement they create. Curation becomes even more important if more than one image is used to seed the generator which can be directed to blend the images or used as difference poles adjusting for more or less emphasis.

4.5.2 Conceptual Thinking

In an effort to reimaging design, we take this an opportunity to consider the thought processes being taught and the practice of design. From this new perspective AI allows us to reemphasize the thinking part of the process rather than what has been the making part of so many design schools. This class will no longer use any of the traditional software tools which consume so much time in training or at least waiting for students to master them enough to generate results. Critiques of student work can be rid of technical hang-ups and procedural discussions making room for content and communication, values and voice, empathy and ethics considerations. Refinement discussions can centre around concept and prompt verbiage as well as machine learning that uses search histories and how other students using the same prompt will produce different results. Like search strategies, we will develop machine learning strategies to conjure something based on our own thought processes. In real time suggestions of concepts can be generated and group discussion centres on the artifact, distancing the student from their technical ability toward their nuanced description in the prompt. In real time suggestions can be generated and group discussion centres on the artifact distancing the student from their technical skill and hone their descriptions' nuance.

4.6 Analysis

4.6.1 Critical thinking

What are the expected outcomes? What are the potential consequences if user behaviour changes in large numbers? What are the political, environmental or social implications of the design's success, failure or extreme use cases? At this point in the process a thorough look at the elements produced from the pipeline and the relationship between the elements is needed. A method for this stage considers Entities, Relationships, Attributes and Flow or ERAF model (Kumar, 2012) which attempts to connect the elements and their qualities to determine the relational meaning. A simple example is an image of Shakespeare's Hamlet with an apple on a desk. We may all agree we are looking at an empty English class but what is it communicating to the viewer? Is it the kind of desk you would see in a public school? A private school? Why do we assume it's an English class? Is it intimidating, should it be, and why is it empty? Was this supposed to celebrate Shakespeare's birthday? Is this the best image for the message we are trying to convey. In addition to using the ERAF model to assess prototypes students will pose ethical questions concerning the bias we bring to the prompts as well as the larger questions about the training of AI systems in general.

4.6.2 Quality definition

The level of AI image quality and compositions is high and ready for print production. Newly released AI image enlarger addresses the age-old issue of making low resolution photos larger which will be introduced early in the production pipeline. In addition to image and compositional quality the soft qualities such as messaging, tone, perception and value are increased as part of the designer's new role. This is not to advocate for aesthetic taste setting or highbrow declaration of the Avant Garde but an indication of selective determinations of what is important for the design to function as intended. Additional time will be spent on the evaluation of quality characteristics from AI results and weigh the importance, significance or other influences put on an image to carry a message.

4.7 Evaluation

4.7.1 User testing

In this course simple A/B testing to collect user feedback will be done with outside participants. Time permitting surveys and self-reporting methods will be used to collect data for print-based projects. Feedback will also come in the form of user logs or analytics tools in the case of a website or web app prototypes. Test results will be compared to the brief and refinements will be made to prompts if user responses do not meet expectations. A comparative test will be done with second and third versions of the project. Students will have a better sense of the pipeline and how the tools work by this time to produce multiple solutions. Assessments of the course include project duration and formal reporting of time spent on the different segments as well as overall timeline for each project.

5 Conclusion

There are likely many other strategies for using these tools as well as approaches to building a pipeline that connects them. This paper is meant as a provocation for design educators to begin the conversation around machine learning tools and how we will use them in design courses. A clear indication that AI will become part of future designer's tool set is evident in the embrace of their use online as well as their integration into current design software tools such as Adobe. Unlike other technologies that have come and gone were often over-hyped but did not meet expectations, machine learning models have improved over a short time comparatively, making predictions that have demonstrated their value in decision support. Design is a series of decisions and using AI in the production of materials saves time and reduce expenses in the process. This is not to say that there has not been enough attention paid to AI but it is difficult to determine its full impact on the design industry. Observing the behaviours of companies that use design is a better indicator than popular media. The financial benefit to using AI is also a consideration, but to whom and to what effect? Preliminary and postproduction processes will also change because of the speed, ease and time saving that machine learning offers. Designers who embrace these tools will develop their own strategies and processes to improve their work, but anyone can learn to write effective prompts, considered results that are proven effective will differentiate the novice from the expert users of AI. We would be remiss to think the technologies will not affect design and these tools are more powerful than any updated suite of software tools. Design educators must learn from previous advances in design processes and use this opportunity to direct how AI tools will affect future designers.

References

Banathy, B. H. (1987). Instructional systems design. Instructional technology: Foundations, 85-112.

Cross, N., & Roozenburg, N. (1992). Modelling the design process in engineering and in architecture. Journal of Engineering design, 3(4), 325-337.

Kumar, V. (2012). 101 design methods: A structured approach for driving innovation in your organization. John Wiley & Sons.

Kwon, K. S., Rahman, M. K., Phung, T. H., Hoath, S. D., Jeong, S., & Kim, J. S. (2020). Review of digital printing technologies for electronic materials. Flexible and Printed Electronics, 5(4), 043003.

Lazzaro, R. (2004). Why we play games: 4 keys to more emotion. In Proc. Game Developers Conference 2004.

Mahesh, B. (2020). Machine learning algorithms-a review. International Journal of Science and Research (IJSR).[Internet], 9, 381-386.

McIlroy-Young, R., Kleinberg, J., Sen, S., Barocas, S., & Anderson, A. (2022, July). Mimetic models: Ethical implications of ai that acts like you. In Proceedings of the 2022 AAAI/ACM Conference on AI, Ethics, and Society (pp. 479-490).

Muybridge, E. (2012). The human figure in motion. Courier Corporation.

Osborn, A. F. (1953). Applied imagination.

Smith, R. E., Chen, J., & Yang, X. (2008). The impact of advertising creativity on the hierarchy of effects. Journal of advertising, 37(4), 47-62.

Smith, R. E., & Yang, X. (2004). Toward a general theory of creativity in advertising: Examining the role of divergence. Marketing theory, 4(1-2), 31-58.

Substack, L (2023) How to create consistent characters in Midjourney, Inside My Head blog post https://linusekenstam.substack.com/recommendations

van Veen, B. L., & Ortt, J. R. (2021). Unifying weak signals definitions to improve construct understanding. Futures, 134, 102837.

About the Authors:

Gerry Derksen: Professor Derksen's published research includes interactive media, visualization in digital humanities, and communication for behaviour change. Currently at Clemson University in Graphic Communications his PhD dissertation from the University of Illinois is titled, "A Smart Toy to Aid Children with Autism".

Acknowledgement: Funding and support for this research was provided by Clemson University in South Carolina, USA.