

CULTURALLY GROUNDED SPECULATION: FRAMEWORK FOR ETHNOGRAPHY INFORMED AI- DRIVEN DESIGN FOR DIVERSE FUTURES

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ABSTRACT

Novel advancements in design processes, such as broader consideration of context and culture to address complex global challenges, along with the emergence of generative AI to aid in ideation and iterative prototyping, necessitate equipping design students with a deep understanding of the people and societies they serve, as well as responsible AI usage. Speculative design practices harness the power to envision collective, ideal futures, which is helpful in addressing complex, wicked problems, however, the practice has been accused of producing Western-centric outputs. Generative AI presents an additional challenge in developing culturally relevant design solutions given its inherent biases limiting designers' capabilities. This study employed a mixed-method approach to investigate how designers can utilise AI technology to visualise culturally relevant depictions of the future and create speculative design outputs solving wicked, culturally driven problems. The results showed a clear need for integrating AI into the design process and highlighted the current pitfalls of AI image-generation platforms. The proposed design process addresses these gaps by leveraging ethnographic research principles to create contextually based generative AI outputs for speculative design ideation. This process allows designers to robustly imagine how future trends and technologies fit into wider cultural contexts. It exemplifies the view that responsibly engaged AI technologies augment human abilities, providing a new layer of intelligent sociocultural considerations for creatives to reference in their design process and evaluate with affected communities.

Keywords: Design education, generative AI, speculative design, innovation design, behavioural science, ethnographic research

1 INTRODUCTION

Designers and creatives have begun to employ generative AI platforms for tasks that would have previously been carried out by humans, potentially altering creative processes [1]. Particularly, generative AI is being integrated into the initial stages of a design process for exploration, ideation, and digital prototyping [2, 3]. As a result, there is a rising necessity for design educators to include AI literacy in their curricula to ensure students are integrating the technology collaboratively and are prepared for the job market, especially considering creative professional work is at a high risk of automation [4]. In addition to educating students on AI technology, the scope of design is expanding to include creative solutions for complex, wicked problems - many of which tend to be culturally determined [5]. It has been argued that the nature of global problems has evolved into a network of connected issues that designers should engage with as a system [6]. This skill can be acquired by analysing how communities are affected by an issue as a whole and carving out the space for those affected to be involved in the co-design and co-production of the solution [6]. Moreover, the nature of wicked problems that designers engage with often requires creating innovative solutions to solve for 'value divergence,' defined as stakeholders' conflicting values in the face of complex issues [7]. These notions point to a need for design educators to impart a deep understanding of the context students are operating within to design interventions that tackle system-wide wicked problems whilst including diverse stakeholder perspectives and culturally specific environments. The rise of generative AI in the creative field presents a challenge because AI technology, as it is currently produced, is unable to meet the needs required to co-creatively design solutions for diverse stakeholders and global environments. AI technology is known for propagating cultural biases and Western perspectives [8] limiting its ability to handle complex

and wicked problems presenting potential dangers in its application to the design process. Therefore, when it comes to the implementation of generative AI platforms in the design process, there is a rising demand for creatives to be provided with guidance on ethical AI usage in design [9] and responsible co-creation with generative AI to enhance creativity and innovation [10]. Efforts have been made to ensure an ethical approach to the development and deployment of AI [11], however, how these efforts are put into practice is dependent upon their application and requires more research into ethical AI use for design. Nevertheless, although flawed, AI technology holds the power to collaboratively produce culturally relevant, future-forward solutions alongside designers. The field of AI ethnography proposes an anthropological study of datasets to ensure AI models are capturing the diversity, culture, and values of humans. Through the practice, we can analyse datasets used to build models and pinpoint where the issues of missed cultural representations occur [12]. More research is needed to learn how to use AI to assist in designing for cultures other than our own and further contextualise future innovation by developing diverse and representative datasets. In addition, to untangle wicked problems, speculative design presents a potential solution enabling designers to apply foresight practices to create probes that challenge the limits of our existing systems and provide new forms of visual representation of technology, opening up a variety of possibilities for debate [13]. However, like generative AI, speculative design as a discipline has been criticised for creating outputs made ‘by, for, and through the eyes of the western, intellectual, middle classes,’ dealing with issues tangible to its own privileged audience and failing to work with surrounding communities [14]. Although speculative design has the potential to be a tool that makes imagining futures and provoking discussion surrounding wicked problems accessible to all, these critiques must be addressed for the practice to live up to this potential. In summary, designers are increasingly being tasked to solve complex, culturally driven wicked problems that require a deep understanding of diverse stakeholders’ perspectives and environments to solve. The rise of AI technology’s integration in the creative process presents a challenge in developing these solutions given its biases that limit the designer’s capabilities in creating culturally relevant outputs. There is a demand for design educators to propose new creative processes that integrate AI in a culturally sensitive way to solve complex, wicked problems. Further research is needed to understand the combined capabilities of AI ethnography and speculative design in a design process to address these gaps. Therefore, in this study, we aim to investigate how designers can harness AI technology to visualise culturally relevant depictions of the future to create speculative design outputs in order to ultimately solve wicked, culturally driven problems. The guiding research questions read as follows:

- RQ1: How are design students currently utilising generative AI technology in their creative process?
- RQ2: How can a creative process be designed to promote cultural relevancy and reduce bias in AI image generation for creative outputs?
- RQ3: How might we utilise generative AI technology to speculate about contextualised future scenarios for creative output inspiration?

2 METHODS

2.1 Participants

A total of 15 students were recruited from a postgraduate campus class for a questionnaire, using convenience sampling in the School of Art, Design, Media by invitation. As students took a course about learning how to use AI image generators for creative outputs including product design, futures scenario building, and artistic pursuits, they held prerequisite knowledge on AI technology for the design process, providing this research with deeper insights on AI usage. Three researchers from this study (and postgraduate Design Engineering students) participated in the subsequent auto-ethnographical phase of the investigation.

2.2 Research design

To best pursue the aims of this research, the study employed a combination of both quantitative and qualitative methods in an explanatory sequential design where a quantitative study phase was used to inform a qualitative investigation [15]. This design is widely employed to evaluate the effects of context and various influences in which one method enriches another for a robust and comprehensive analysis [16]. The study consisted of two stages. In the first, a small-scale exploratory questionnaire was shared with a class of postgraduate design students with background knowledge in AI image generation to gather data on their generative AI usage and validate the research mandate. Following the questionnaire,

a qualitative auto-ethnographic approach was employed to further investigate the capabilities of introducing AI in a design process to contextualise the images generated and produce culturally relevant speculative design outcomes. First, an autobiographical method was utilised to test and select an appropriate image generation platform for the research aim. Subsequently, a criterion was crafted by which to evaluate the generative AI outputs to be able to detect the level of cultural relevancy of the intended context. The last phase consisted of producing culturally relevant speculative imagery grounded and informed by future trends.

3 FINDINGS AND DISCUSSION

3.1 Exploratory questionnaire results

The questionnaire aimed to uncover how students in a postgraduate design program are currently employing generative AI technology, considering the tools and platforms they are utilising, and their opinions on AI integration into the design processes. The questionnaire was completed by students specialised in diverse design fields including product design, urban design, game design, animation, and AI computer engineering with a foundational understanding of AI image-generation. 67% of students had utilised AI image generation products before and 33% of respondents mentioned Stable Diffusion as their most used product. 47% used AI to generate image/video for animation design and when asked what they found most challenging about AI, the majority of respondents selected “prompt writing” and “getting a desired outcome” as their answer. However, 87% of respondents were likely to extremely likely to use AI again in a future creative project. Lastly, when asked if design students saw any issues in using generative AI products for creative ideation and inspiration, respondents answered with “ethical and copywriting issues”, “lack of control”, “the amount of tweaking you can do with some of the tools can be quite overwhelming and post-processing is often necessary to get decent results”. These results show a clear need and enthusiasm by design students to integrate AI technology into their creative process, however, students raised valid concerns regarding responsible and ethical AI usage, further validating the research aim to investigate the potential of a design process that integrates AI in a culturally appropriate and sensitive manner.

3.2 Initial Generative AI Platform Experimentation

Research tells us exposing design students to cutting-edge technology, including its foundations, uses, and development can stimulate innovative solutions to wicked problems [17]. This investigation fulfils the students’ needs found in the questionnaire by providing them with a structure to ethically incorporate AI into their practice promoting a stimulus for students to design solutions to wicked problems. Therefore, our second research aim was to investigate how AI can be incorporated into the design process to increase cultural relevancy and reduce the chance of bias. To do this, it was imperative to develop a process that facilitates culturally sensitive outputs operating within current AI technology offerings. We began by identifying Stable Diffusion Automatic 1111 Web UI interface [18] as the most suitable platform to integrate within what we have coined as the “ROOTS: Grounding AI” process. Stable Diffusion as a platform provides the highest level of customisability giving students the option to choose models from online communities such as Huggingface [19]. Additionally, more than 300 plugins are available through the automatic 1111 platform, further expanding students' options. We then evaluated Stable Diffusion's success rate in depicting the present in a culturally informed way. To standardise our results, we used this question: ‘*How do Hawker Centres function in Singapore today?*’ during an international placement in the region, as guidance to depict simple, everyday acts of eating or drinking in public hawker food markets. We conducted ethnographic testing, comparing images the researchers took to images generated by Stable Diffusion using descriptive prompts. Results from these initial tests showed us that the model alone could not fully capture the nuances of culturally specific environments and interactions. Figure 1 shows an example from the results of these initial tests.



Figure 1. Initial tests with Stable Diffusion showing stereotypical representations of Singapore

We then conducted further ethnographic research and experimented with the addition of various plugins into the Stable Diffusion workflow to get a more accurate representation of present Singapore. Observational research and photographic artefacts were utilised as inputs to engineer hyper-specific prompts and newly generated images. By employing the ControlNet with Depth extension [20] on users' uploaded photos, a depth map of that image is created. An AI-generated image can be made building onto the depth map of the original photograph, making the overarching structure of the generated image consistent with the uploaded photo [21]. We evaluated the success of the images by assessing “How realistic are the generated outputs?” and “How closely were the prompts followed in the outputs?” for every image generated. The criteria outlined in these two questions allowed for further refinement of the process. The results of this exploration, as shown in Figure 2, showed Stable Diffusion to be successful in generating culturally informed outputs when hyper-specific prompts and real images sourced from the environment were used as the foundation.



Figure 2. ControlNet Extension to generate image depth, leading to a more accurate output

3.3 Applying the “ROOTS” process for generative AI speculative design

Using the guiding question of “How will Hawker centres function in Singapore in the future?” we moved to examine how the “ROOTS” process might be applied to imagine how the interaction previously tested might look in the future for speculative design production. The first step in doing so was identifying possible futures to envision. Using the Singapore Centre for Strategic Future’s Foresight report [22], two key possible future trends were identified. Firstly, Singapore’s movement towards sponge city infrastructure as a solution to increasing inundation, and secondly, Singapore’s incorporation of SMART city technologies. Applying our process to imagining how interaction scenarios at Hawker centres might look if these possible futures became a reality allowed us to examine whether generative AI could accomplish a contextualised depiction of future Hawker centre scenarios. To speculatively imagine how these future trends might look in a Singaporean context, we used the Stable Diffusion setup outlined in the prior paragraph and updated prompt keywords from the present-day context with new keywords describing the selected future trend. Figure 3 shows two examples of speculative images depicting Singapore as a sponge city and with SMART city technology respectively. Comparing these future images to the original images of the present taken during ethnographic research, it is clear to see instances where cultural codes and connotations have carried through.



Figure 3. Left to right: original photograph, sponge city future, SMART city future

This last step allowed us to finalise the “ROOTS” process, with the aim being for the process to be used within design research and design education to generate images used to open discussions on wicked problems and critically reflect on how possible futures might look as a solution. Figure 4 depicts the “ROOTS” process, representing a path towards ethnically incorporating AI into the design process, whilst tackling relevant wicked problems in a culturally grounded, focussed manner.

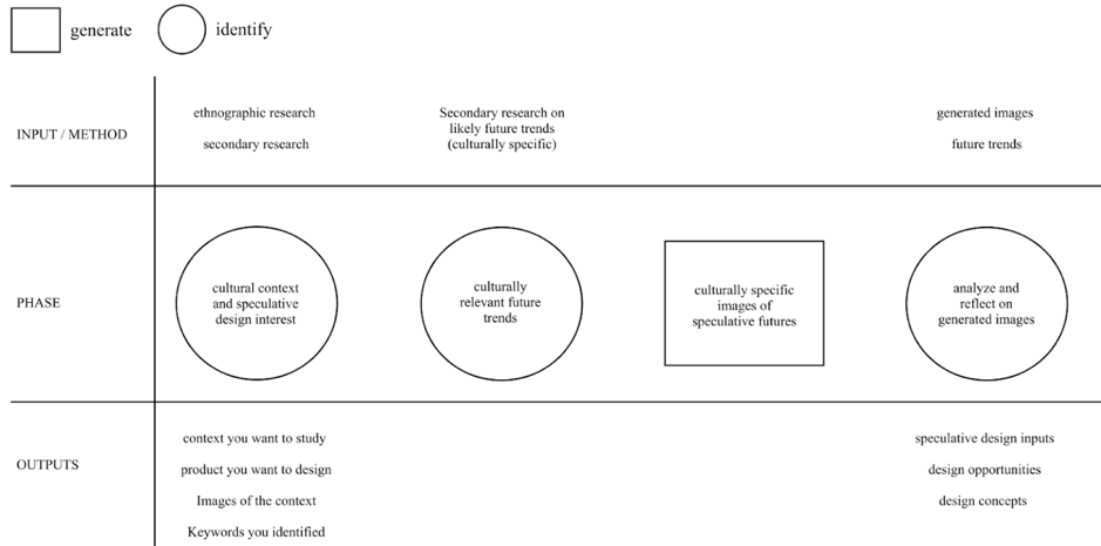


Figure 4. The ROOTS process from input to generation

4 CONCLUSION AND LIMITATIONS

Our research findings demonstrated that students are promptly adopting AI into their workflow for its great potential, however with valid concerns relating to ethical and responsible usage. Design education must provide students with guidance on responsibly incorporating AI in design processes. The rise of generative AI is accompanied by the expansion of design goals to incorporate solving system-wide, wicked problems through speculative design. For these developments to co-exist, designers need to have greater cultural awareness, whilst incorporating AI and speculative design in a culturally sensitive way. The goal being to ethically co-design future solutions with stakeholders, a rising need in collaborative generative AI usage [23]. The “ROOTS” process offers a framework to address these challenges, drawing on principles of AI ethnography to pave the way for ethical AI usage within the design process, particularly in the ideation, visual prototyping, and iteration stages of interventions, including designed products. The process can be applied to creative teams who engage with communities in the creation of a design intervention such as urban planners ideating on the design of public spaces, foresight practitioners looking to conceptually visualise ideal futures, and designers speculating on future services and products. However, it must be noted that this process is not without limitations. Firstly, the images generated using the “ROOTS” process mustn't be seen as final outputs, but rather as a catalyst for critical discussion and ideation. Secondly, the process should be used with caution, and by individuals who have

developed prior knowledge of the biases within AI datasets in order to utilise ethnographically informed inputs. Lastly, future research should further validate the process with diverse stakeholders.

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