# Universal Design versus User Custom Design

John Akers

The field of user experience design has existed much longer than the computer interface, but ever since computers became ubiquitous a continuous challenge has arisen to improve the usability of applications. Original computer interfaces were catered solely towards developers with command based inputs, which then shifted to visual desktop analogs as personal computers became widely commercialized for the general public [1]. Both of these eras focused on designing systems to be efficiently utilized by the average user with little to no concern for the outliers among the user base. Supporting non-standard individuals in systems designed this way often involved adding additional features and functionality for each unique use case.

The concept referred to commonly as universal design was first discussed in the 1960s but has seen growing popularity among the computer interface design community throughout the past two decades. This design technique focuses on creating equitable and accessible designs for all individuals with varying capabilities. Universal design has seen success in empowering individuals who are otherwise normally severely disadvantaged in accessing technology and is seen as an overall positive shift in the design space for its noble objectives.

Undoubtedly universal design is an improvement over the previous standard of only catering to the average user but little effort has been made to understand the consequences of designing systems in such a general way that they may be used the same by all. Compared to the timeline of other technological advancements, the concept of universal design is relatively old and other innovations since universal design's conception may enable an even better approach.

One such approach which has seen continuous use despite varying success is the idea of user customized interfaces. This idea is similar to universal design in supporting more than just the standard use case, but instead of adding functionality to support a diverse set of users, designs are created such that the user can make their own changes in a way that preserves the purpose of the application while allowing each user to best fit their own needs. User customized interfaces when done correctly allow each individual to utilize applications in the way most efficient for themselves instead of ensuring an equitable experience.

This article will go into more depth about these two design stances, evaluating not only the main values achieved by each but also discussing some research conducted on the effectiveness of each approach. Both the positive and negative impacts of these design stances will be explained in more detail and this article will also discuss some of the ways newer technologies could be leveraged to enhance these approaches to design.

The Centre for Excellence in Universal Design defines universal design as "the design and composition of an environment so that it can be accessed, understood and used to the greatest extent possible by all people regardless of their age, size, ability or disability."[2] The term is further supported by seven principles which consist of: equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach and use. Many of these principles are good design practices in general,

with only a few such as equitable use and a low physical effort requirement being specific to universal design.

In 2012 a group of researchers from the University of Georgia assessed the use of universal design. Their study focused on the impacts of group note-taking within large lecture environments [3]. The study harnessed universal design by enforcing a collaborative dynamic, with different groups of students recording lecture notes each week such that the entire class had equitable access to the same notes. Other groups would then grade the quality of the notes for that week in an attempt to ensure a standard of quality on the notes. The class was split into two sections with one section using the new group note taking system while the other followed the regular structure of the course. At the end of the term the test scores of the two sections were compared and the students were surveyed about their perspectives on the new system. The results showed a notably higher average final test score for the section using the shared group notes, however, a majority of students indicated they would have preferred to do individual work instead of taking group notes with many believing they had performed more than their fair share of the work.

This case study highlights one of the potential downsides of universal design: creating an equitable experience for all is intended to be beneficial for outliers but can also mean degrading the experience for others. In this specific case universal design was intended to ensure all students had equal access to lecture notes but resultantly caused some students to do a disproportionate amount of the work. Another objective of the study was to improve students note taking abilities through the peer review process, but 65% of students believed at the end of the term their skills had not changed at all. This highlights another flaw with universal design: a designer still needs to make considerations for every potential use case, which may be impossible in circumstances where every individual may best use a system differently.

A solution to these issues is to design systems in such a way that users can make their own customizations to best fit their specific needs, one of the core principles behind user customization design. Also referred to as adaptive design, this approach differs from universal design by acknowledging that a single or even a few designs will not always be sufficient to accommodate the variety of users and that individuals may want to make small adjustments to their experience. User customized designs have been researched in a variety of contexts such as personal portfolios [4] and gamification [5].

In 2013 an evaluation was conducted of advanced user interface customization by researchers at the University of Auckland to see the impacts of providing users greater control over interface design in applications at runtime [6]. The study separated potential customizations into two categories: layout customization such as moving and resizing visual elements within an application, and functional customization such as linking components together to process or display information in different ways. Technical users were brought in to perform a series of tasks with a demo application and results of the study were collected through survey questions as well as from a post experiment discussion with the participants. The results of the study found that most users encountered elements of the layout and functionally they wanted to customize and would find such features useful in other applications they used.

User customized designs can be beneficial for tweaking an application for each user to have a perfect experience but there are some potential downsides as well. Similar to universal design, user customized design requires designers and developers to decide which elements of the application can be modified by the user and to what amount. Designing an interface that can be customized by users at runtime also requires creating a customization interface that is intuitive to understand and manipulate. Furthermore, allowing users to modify functionality of applications can lead to errors in the program or potential security issues. The core issues that arise from user custom designs are predominantly caused by deciding how and what parts of an application may be customized.

A promising technology that has been exploding in use over the last few years which could solve these problems is machine learning. At a high level machine learning could be harnessed to recognize patterns in application use and automatically adapt the application to improve usability. This technique could be applied on a per user basis to modify applications to fit each person's needs without any kind of complicated customization interface. Letting machine learning handle customization also allows for a much wider array of parameters to manipulate than a human operator could handle. On a per-session basis machine learning can also infer what actions a user is trying to accomplish and reduce the number of steps that must be taken by the user.

Machine learning is already used to perform per user customizations on platforms such as Facebook and Youtube, where content is displayed and suggested to users based on their viewing history. Much work has already been put into learning user's preferences and habits in order to cater experiences to each individual, however, applying this information to adaptive user interfaces and interactions is still rare in application design.

The HCI community has already begun to research the impacts of this new iteration of adaptive design [7]. Machine learning based design presents a challenge unlike any other form of design: an unpredictable process flow through applications, making usability testing more difficult for designers. Another issue, from the user side, is the inconsistency in user experience both between separate users as well as between sessions when the application is still adapting. There is also the important ethical question concerning allowing user experience to be almost entirely controlled by machine learning algorithms instead of manually created by designers. Researchers believe these shortfallings will become less of a problem as society adjusts to more dynamic interfaces, but widespread use of this technique has yet to be seen.

In the context of universal design and custom user design, machine learning appears to be the best solution to existing flaws, and while using machine learning brings its own issues it still has the potential to drastically improve application design. Machine learning could usher in a new era of application design with highly personally catered experiences without putting the burden on the user to customize it.

[1] Andrew Ko. 2018. User Interface Software and Technology. A history of user interfaces, Ch. 1. University of Washington. Retrieved February 19, 2019 from https://faculty.washington.edu/ajko/books/uist/history.html

[2] Universal Design. Centre for Excellence in Universal Design. Retrieved from http://universaldesign.ie/What-is-Universal-Design/

[3] Christopher Plaue, Sal LaMarca, and Shelby H. Funk. 2012. Group note-taking in a large lecture class. In Proceedings of the 43rd ACM technical symposium on Computer Science Education (SIGCSE '12). ACM, New York, NY, USA, 227-232. DOI: https://doi.org/10.1145/2157136.2157203

[4] Pascal Lessel, Maximilian Altmeyer, and Antonio Krüger. 2018. Users As Game Designers: Analyzing Gamification Concepts in a "Bottom-Up" Setting. In Proceedings of the 22nd International Academic Mindtrek Conference (Mindtrek '18). ACM, New York, NY, USA, 1-10. DOI: https://doi.org/10.1145/3275116.3275118

[5] S. Shyam Sundar, Jeeyun Oh, Saraswathi Bellur, Haiyan Jia, and Hyang-Sook Kim. 2012. Interactivity as self-expression: a field experiment with customization and blogging. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12). ACM, New York, NY, USA, 395-404. DOI: https://doi.org/10.1145/2207676.2207731

[6] Clemens Zeidler, Christof Lutteroth, and Gerald Weber. 2013. An evaluation of advanced user interface customization. In Proceedings of the 25th Australian Computer-Human Interaction Conference: Augmentation, Application, Innovation, Collaboration (OzCHI '13), Haifeng Shen, Ross Smith, Jeni Paay, Paul Calder, and Theodor Wyeld (Eds.). ACM, New York, NY, USA, 295-304. DOI: http://dx.doi.org/10.1145/2541016.2541037

[7] Qian Yang, John Zimmerman, Aaron Steinfeld, and Anthony Tomasic. 2016. Planning Adaptive Mobile Experiences When Wireframing. In Proceedings of the 2016 ACM Conference on Designing Interactive Systems (DIS '16). ACM, New York, NY, USA, 565-576. DOI: https://doi.org/10.1145/2901790.2901858