



UX Analysis of Desmos

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INTRODUCTION

What is Desmos?

According to [desmos.com](https://www.desmos.com), Desmos is a high class online HTML5 graphing calculator designed for millions of students around the world to use for free. Desmos aims to “help every student learn math and love learning math” through the creation of digital math tools that enable equal access to anyone through the Internet and also has created activities on top of their graphing calculator that help students utilize Desmos to the highest possible experience that Desmos has to offer.¹

Research Goals

In this study, we would like to research how Desmos operates and evaluate the user experience of Desmos. We would like to learn how well Desmos works for users and likewise, learn if it has flaws that fails to work well for users. Then we would like to evaluate the overall success of Desmos’s socio-technical design.

Research Methods

In order to carry out this study, we will be testing the desktop version of the Desmos graphing calculator against Nielsen’s 10 Heuristics for User Interface Evaluation.² We will utilize the system first hand and then evaluate the system based on these 10 Heuristics. We will analyze the not only the strengths, but also the weaknesses of Desmos and then holistically grade how well the system performs for every single heuristic on a scale from poor, average, to excellent.³

¹ Desmos. “What We Do.” 2018. <https://www.desmos.com/about>

² Nielsen, Jakob. “10 Usability Heuristics for User Interface Design.” January 1, 1995. <https://www.nngroup.com/articles/ten-usability-heuristics/>

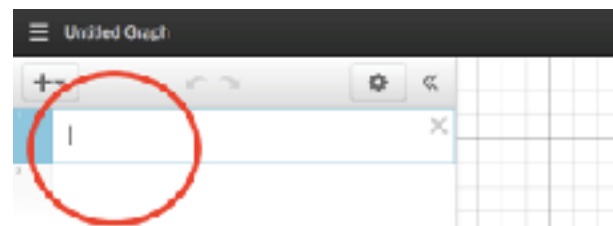
³ Nielsen, Jakob. “How to Conduct Heuristic Evaluation.” January 1, 1995. <https://www.nngroup.com/articles/how-to-conduct-a-heuristic-evaluation/>

HEURISTIC EVALUATION

Visibility of system status

According to Nielsen, visibility of system status is characteristic of user experience where a system “should always keep users informed about what is going on, through appropriate feedback within reasonable time”. In other words, an information system should constantly be explicit about what it is doing on its display.⁴

Desmos in this aspect, is very explicit on what it's system is doing. When the user first opens the graphing calculator, the display makes it very clear that the user should type in a function on the left hand column to create a graph by providing a visual cue of a familiar flashing text line.



Then the system, provides immediate feedback while the user types in their functions by either graphing the function on the plane to the left or by displaying a yellow warning sign to signal that it could not graph the invalid function that the user inputed.

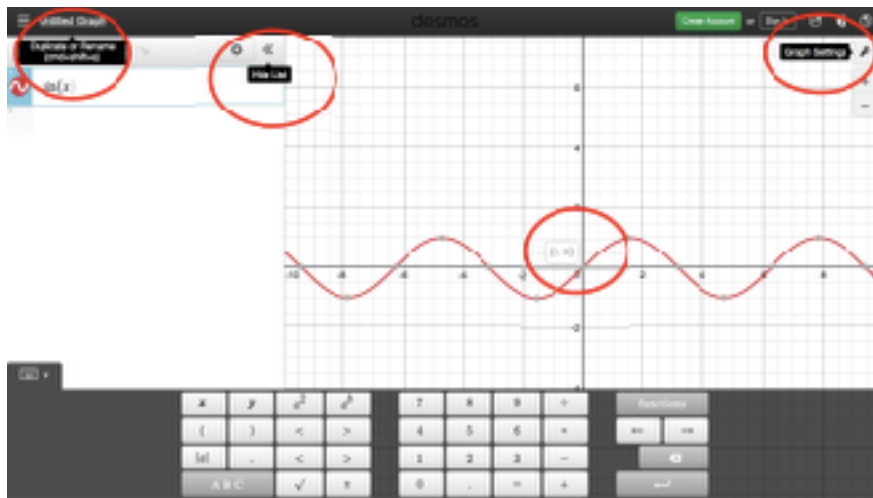


The speed of feedback happens so immediately that there is virtually no lag where users can be confused as to what the graphing calculator is doing. Therefore, we evaluated the visibility of system status as: excellent.

⁴ Nielsen, Jakob. “10 Usability Heuristics for User Interface Design.” January 1, 1995. <https://www.nngroup.com/articles/ten-usability-heuristics/>

Match between system and the real world

“Match between system and the real world” as defined by Nielsen is a characteristic that an information system should convey information logically through the use of user-familiar terms, rather than system-oriented terms.⁵ Desmos against this heuristic at first glance, may seem to fail due to the extreme lack of text on screen. However, when interacted with, simple definitions of all of its icons and buttons appear through the simple motion of hovering over with the cursor.



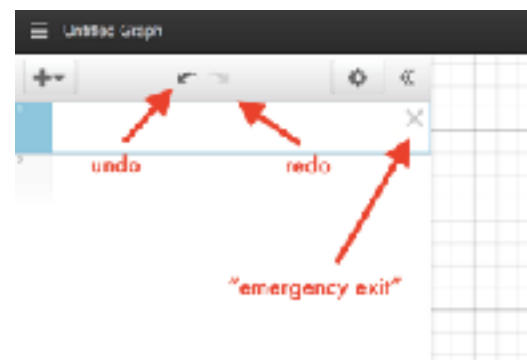
Therefore, we evaluated the match between system and the real world as: excellent.

User control and freedom

Information systems with good user control and freedom, as characterized by Nielsen, are systems that have basically three support functions:

- An “emergency exit”
- Undo
- Redo⁶

Desmos contains all of these functions. Therefore, we evaluated the user control and freedom of Desmos as: excellent.



⁵ Nielsen, Jakob. “10 Usability Heuristics for User Interface Design.” January 1, 1995. <https://www.nngroup.com/articles/ten-usability-heuristics/>

⁶ Ibid.

Consistency and standards

An information system has consistency and standard if a system is consistent with their words, situations, and actions so that users are not confused and according to research done by Raluca Budiu, is one of the most strongest contributors to usability.⁷

To evaluate this heuristic, we have compared this online graphing calculator to the existent graphing calculators, such as the TI-84, and have found that Desmos standards align very well with existing graphing calculators which typically consist of the main functions of being able to input functions, graph functions, and analyze the graphs of functions⁸. In addition, the mathematical characters that are used on Desmos, also are consistent with standard math.⁹

Therefore, we have evaluated the consistency and standards as: excellent.

Error prevention

Error prevention is characteristic of an information system to be able to prevent users from creating errors while using the system. According to research done by Page Laubheimer, there are several ways that a system can achieve this goal. For example:

- Including helpful input constraints to minimize wrong inputs
- Offering suggestions for correct inputs
- Choosing good default inputs¹⁰

Desmos, unfortunately, does not do a very good job against this heuristic. Unlike a normal graphing calculator which constrains users to only mathematical expressions to input, due to Desmos being an online application, users can easily input wrong characters from their QWERTY keyboard that are not math related and does not have any sort of suggested function input or even default function input.

Therefore, we have evaluated the error prevention as: poor.

⁷ Budiu, Raluca. "The Power Law of Learning: Consistency vs. Innovation in User Interfaces". October 30, 2016. <https://www.nngroup.com/articles/power-law-learning/>

⁸ Texas Instruments. TI-84 Plus and TI-84 Plus Silver Edition Guidebook. 2010.

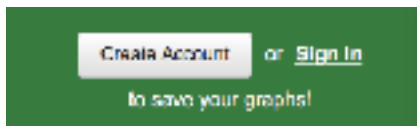
⁹ Loewus, Liana. "Will Online Tools Make Texas Instruments' Graphing Calculators Obsolete?" June 15, 2017. <https://www.edweek.org/ew/articles/2017/06/14/will-online-tools-make-texas-instruments-graphing.html>

¹⁰ Laubheimer, Page. "Preventing User Errors: Avoiding Unconscious Slips." August 23, 2015. <https://www.nngroup.com/articles/slips/>

Recognition rather than recall

Recognition rather than recall is the ability of an information system to promote recognition of information over the recall of information because psychologically, it is easier to recognize things from memory over recalling. There are several ways that Raluca Budiu proposes to promote recognition in User Experience:

- Having a history function or previously visited content function
- Being able to save information (ex. favorites, wish lists, bookmarks, etc)
- Incorporating tips or readily available instructions on how to use a system¹¹



Desmos does offer the ability to save functions users have graphed through the creation of an account and may not have a history function, but as previously mentioned, has an undo and redo button to access previous inputs.

However, Desmos also does not have very reminders that would trigger a user's memory of how to use Desmos, so we have evaluated its recognition rather than recall as: average.

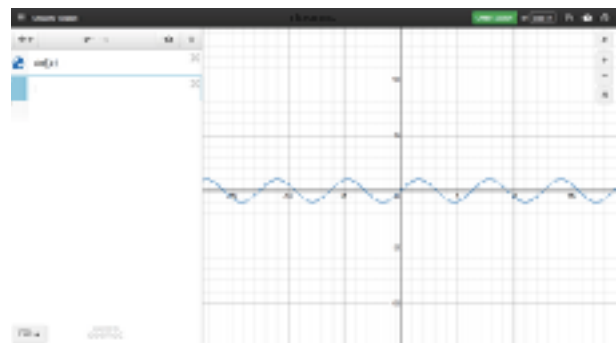
Flexibility and efficiency of use

Flexibility and efficiency of use allow users to tailor their user experience based on their experience with the information system.¹² Desmos against this heuristic does not really have that many settings that the user can change besides the visibility of their tools, so we have evaluated its flexibility and efficiency of use to be: average.

Aesthetic and minimalist design

Aesthetic and minimalist design is the concept that information should be as condensed as possible because every extra bit of information diminishes the relative visibility of all the other information.¹³ With this heuristic, Desmos does an extremely well job of selectively minimizing information through the use of hovering (as previously mentioned in Match between system and the real world) and its minimized use of color in its visuals where only the important features, such as the graph line, are in color.

Therefore, we have evaluated its aesthetic and minimalistic design as: excellent.



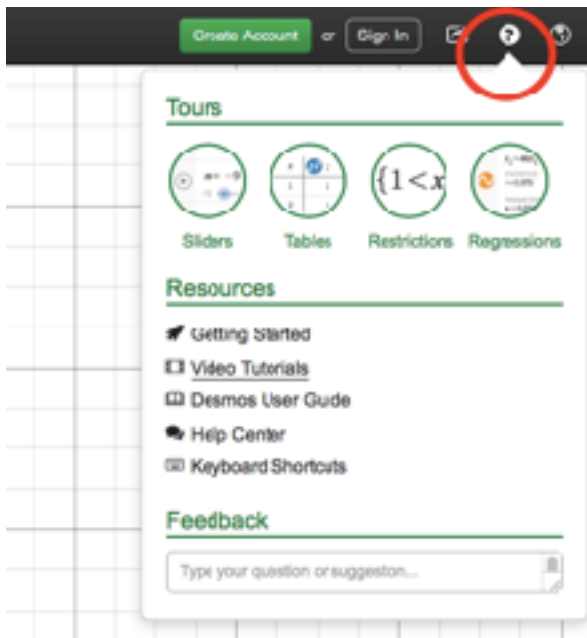
¹¹ Budiu, Raluca. "Memory Recognition and Recall in User Interfaces." July 6, 2014. <https://www.nngroup.com/articles/recognition-and-recall/>

¹² Nielsen, Jakob. "10 Usability Heuristics for User Interface Design." January 1, 1995. <https://www.nngroup.com/articles/ten-usability-heuristics/>

¹³ Ibid.

Help users recognize, diagnose, and recover from errors

This heuristic basically evaluates whether or not an information system has clear error messages that help users recover from a problem.¹⁴ In this case, Desmos does have a warning icon when a user inputs an invalid function(as previously mentioned in Visibility of system status). However, it fails to give any constructive advice on how to go about fixing these invalid functions at all. Therefore, we evaluated Desmos's ability to help user recognize, diagnose, and recover from errors as: poor.



Help and documentation

Finally, the last heuristic that we tested against Desmos is the ability to easily provide help and documentation on how to use an information system.¹⁵

For this heuristic, Desmos makes it very clear where to obtain help through the simple question mark button at the top right of the site. They offer tours on how to use the site, instructional resources that users can be redirected to, and even an option to receive email feedback on questions that they do not have an immediate answer to.

Therefore, we evaluated the help and documentation as: excellent.

¹⁴ Nielsen, Jakob. "10 Usability Heuristics for User Interface Design." January 1, 1995. <https://www.nngroup.com/articles/ten-usability-heuristics/>

¹⁵ Ibid.

CONCLUSION

Heuristic	Evaluation
Visibility of system status	excellent
Match between system and the real world	excellent
User control and freedom	excellent
Consistency and standards	excellent
Error prevention	poor
Recognition rather than recall	average
Flexibility and efficiency of use	average
Aesthetic and minimalist design	excellent
Help users recognize, diagnose, and recover from errors	poor
Help and documentation	excellent
Overall	average-excellent

As represented by the data table above, overall, we have evaluated Desmos to be between average and excellent. Desmos has many strengths to its user experience, such as its instantaneous feedback, hovering function, or help sources. However, it also has many weaknesses such as its inability to help users not create errors or recover from errors. Therefore, to make this system better we would recommend for Desmos to implement more functions to help users with errors such as a math AI that could fix incorrect mathematical inputs. If Desmos could fix these flaws they could increase the quality of Desmos's interaction design and user experience from average-excellent to excellent.¹⁶

¹⁶ Preece, Jenny, Helen Sharp, and Yvonne Rogers. *Interaction Design*. 3rd ed. Wiley.