Polydraw

UI/UX Design

UI/UX Design

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1 | Introduction

Polydraw is a desktop application that allows users to create and edit rasterized shapes with ease. This report provides an overview of the design process for Polydraw's user interface (UI) and user experience (UX). The report covers:

1. **Background**: This section provides an overview of the app's target audience and the design inspiration that guided the development of the UI.

2. **UI Components and Layout**: Here, we detail the main screen layout and key UI components, explaining their functionalities and how they contribute to the user experience.

3. **Accessibility**: We discuss the measures taken to ensure the app is accessible to all users, including considerations for responsive design and adherence to accessibility standards.

4. **Help & Documentation**: This section outlines the support provided to users within the app.

5. **Usability Enhancements**: We highlight features that enhance usability, such as undo/redo functionality, zooming capabilities, and the image export feature.

By the end of this report, readers will gain a comprehensive understanding of the design decisions and considerations that went into creating an effective and engaging user interface for our drawing app.

2 | Background

2.1 | Target Audience

Polydraw is primarily designed for high-school students who are interested in drawing different shapes. This demographic includes students aged 14 to 18, who are often engaged in various academic and extracurricular activities that require or benefit from creative and graphical skills.

User Persona

Although no formal user research was conducted, we developed a persona based on general insights to guide our design decisions. A persona is a fictional, yet realistic, description of a typical or target user of the product. It is used to promote empathy, increase awareness and memorability of target users, prioritize features, and inform design decisions (Kaplan, 2022).

Figure 2.1: Sarah Johnson (studiogstock, 2022)

Demographics:

- **Age:** 17
- **Gender:** Female
- **Occupation:** Student
- **Location:** Mauritius

Background:

- Sarah is an high-school student who enjoys creating various shapes and designs for school projects, presentations, and personal artwork.
- Sarah is highly proficient with technology, regularly using smartphones and computer applications.

Goals:

- Sarah wants to explore geometric shapes creatively.
- She seeks tools that can help her understand mathematical concepts visually through practical applications.
- She prefers intuitive interfaces that are easy to navigate without extensive tutorials.
- She wants to be able to share her drawings with others.

Challenges:

- Needs intuitive features and tutorials to quickly grasp and apply design techniques.
- Limited time between school assignments and extracurricular activities.

Needs:

- **Interactive learning:** Requires a tool that offers interactive tutorials or guidance on drawing shapes and understanding their properties.
- **Feedback:** Immediate feedback on drawing accuracy and alignment.

■ **Customizations:** Ability to customize shapes with different colors, sizes, and patterns to enhance creativity.

Behaviors:

■ Likely to use the application during free time and after school for both leisure and learning purposes.

2.2 │ Design Inspiration

Polydraw's UI was heavily inspired by Geogebra Classic (Geogebra, 2024). This app was chosen as a benchmark due to its intuitive design, user-friendly navigation, and overall positive user feedback. We aimed to incorporate similar elements to achieve a comparable user experience.
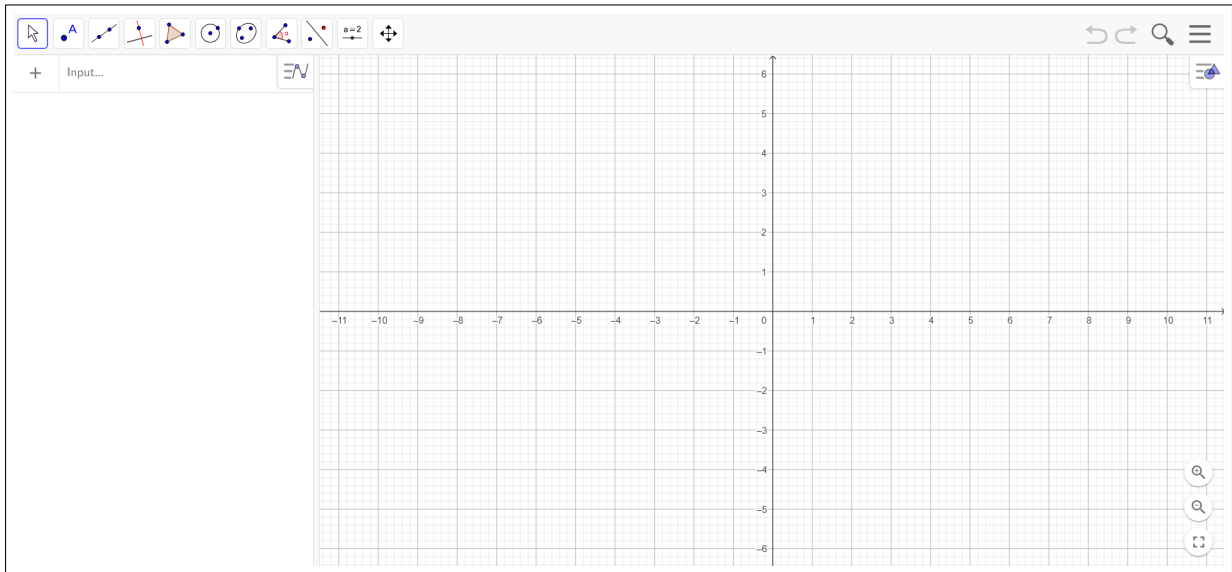
Figure 2.2: Main screen of Geogebra Classic
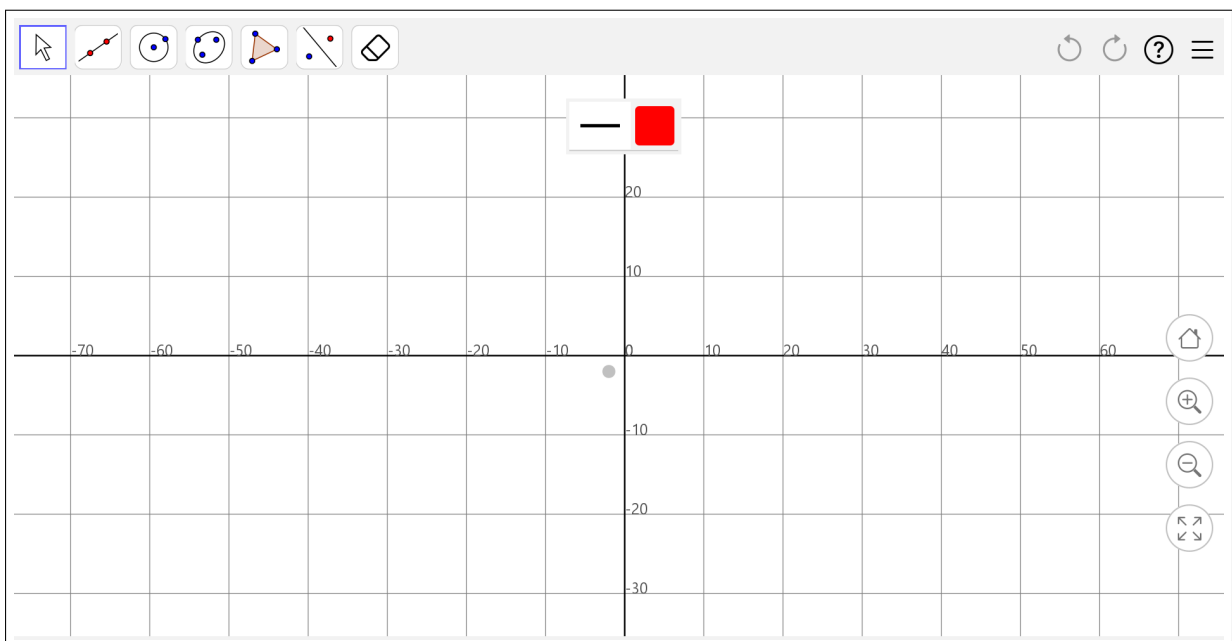
Figure 2.3: Main screen of Polydraw

3 | UI Components and Layout

In designing the UI components and layout of our application, we adhered to Nielsen's (1994) guideline on Consistency and Standards by ensuring uniformity in buttons, icons, and typography across all screens. This consistency helps users predict and understand the interface more quickly. Additionally, our focus on an aesthetic and minimalist design reduces unnecessary clutter, making the interface more intuitive and user-friendly.

3.1 | Layout
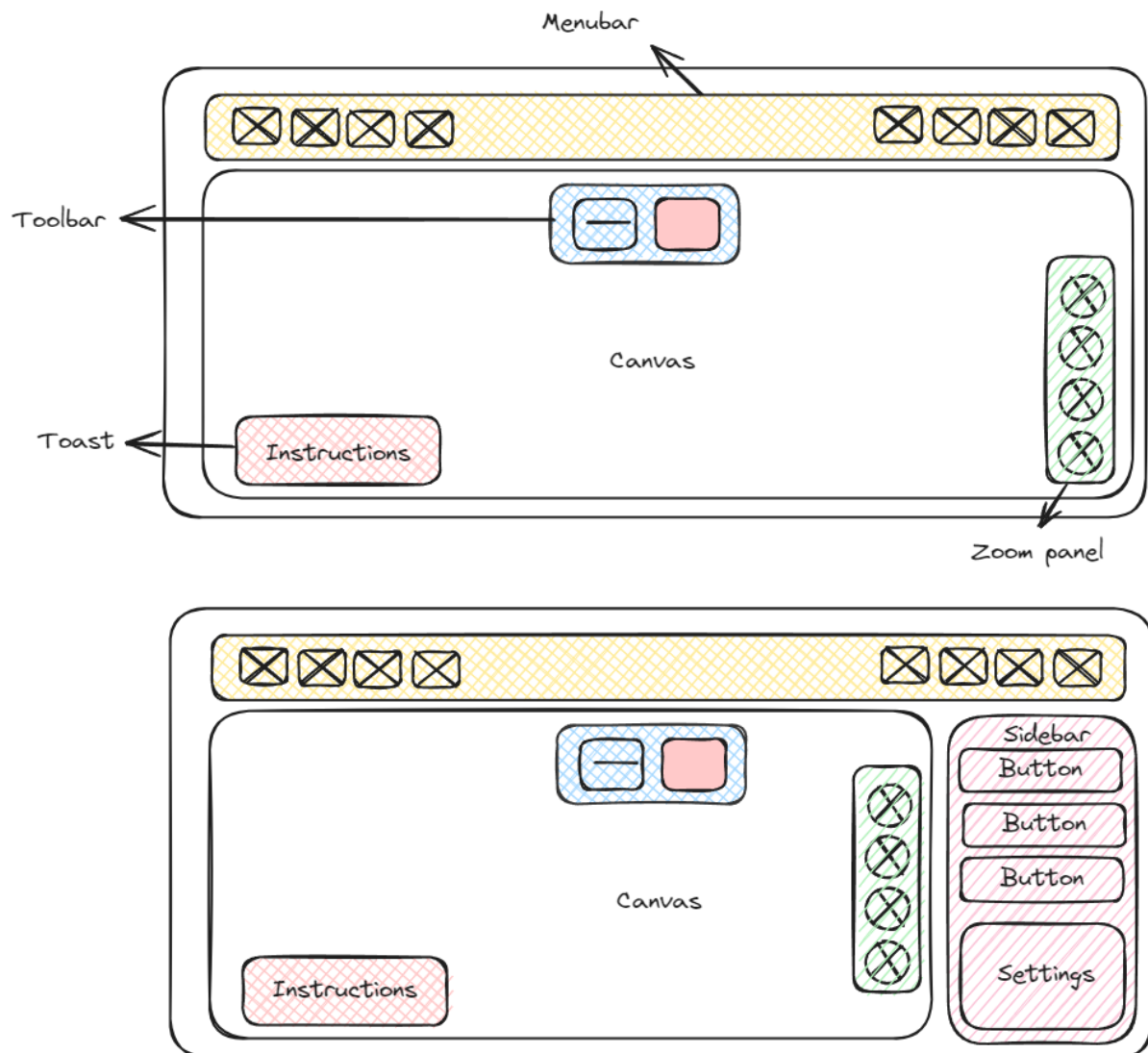
Figure 3.1: Wireframe of Polydraw

The main screen is divided into several distinct areas, each serving a specific purpose:

1. Menubar

   - Located at the top of the screen, the menubar provides quick access to frequently used tools and functions such as Undo and Redo.
   - Icons are grouped by functionality for easy identification and use.
   - The left group of icons contains menu buttons for the different drawing modes.
   - The right group of icons contains control buttons such as undo, redo, delete, and a button to toggle sidebar.

2. Toolbar

   - Located right below the menubar, the toolbar allows users to adjust parameters such as line thickness, line type, and color.

3. Sidebar

   - Positioned on the left side of the screen, the sidebar contains less commonly used options such as clear canvas, export image and canvas settings.
   - The sidebar is initially hidden and can be toggled by clicking on the hamburger icon.

4. Canvas

   - The central area of the screen is dedicated to the drawing canvas, where users create and edit their artwork.
   - The canvas supports intuitive interactions such as clicking and dragging to draw, as well as using the mouse wheel to zoom in and out.

5. Toast

   - Positioned at the bottom of the screen, the toast provides information about the current drawing mode.
   - It disappears automatically after a few seconds to avoid cluttering the screen.

6. Zoom Panel

   - Positioned at the bottom right corner of the canvas, the zoom panel contains button for zooming in and out canvas, resetting the zoom level, and maximizing the canvas.

The layout of the main screen makes use do Gestalt's Law of Proximity which states that objects that are near, or proximate to each other, tend to be grouped together (Laws of UX, no date). For example, all the buttons that control the zoom level are placed close to each other so that users can intuitively find and use buttons that control zoom level.

3.2 | Icons and Graphics

Polydraw relies heavily on icons to enhance usability and provide consistency. Our primary goal was to create a clean, intuitive interface that facilitates user interaction and reduces cognitive load.

To represent the different drawing modes we used graphics from Geogebra (2024). These graphics were selected for their minimalist design.

Figure 3.2: Drawing mode icons

Each graphic illustrates the drawing mode and its instructions. For example, the circle graphic represents the drawing mode whereby a circle is drawn by first selecting the circle center and then another point on the circle.

In addition, we used Bootstrap (2024) icons for common actions and symbols. Bootstrap icons were chosen for their simplicity and wide recognition, ensuring a user-friendly interface. This approach aligns with Jakob's Law, which states that people spend most of their time using digital products other than yours; thus, leveraging widely recognized icons helps users feel more comfortable and reduces the learning curve.
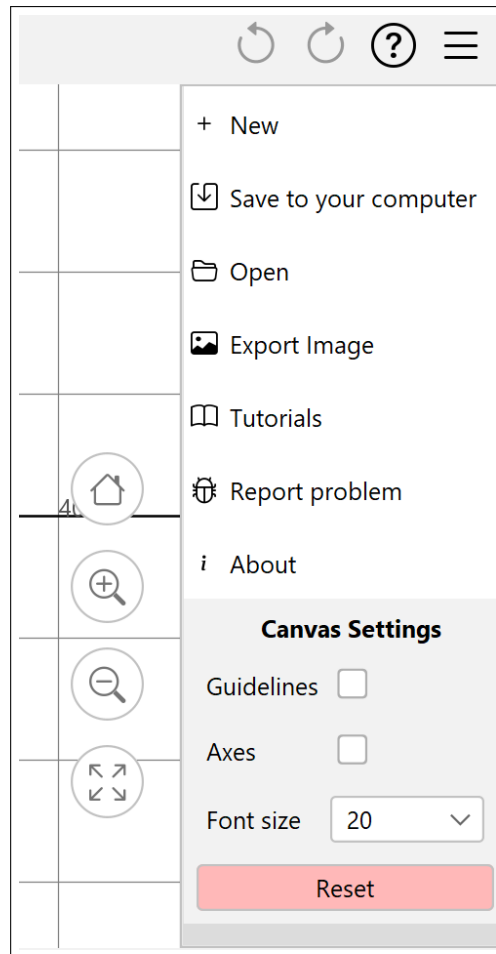
Figure 3.3: Bootstrap icons in zoom panel, menubar and sidebar

Our icons are also vector-based, ensuring that they scale seamlessly across screen resolutions without loss of quality.

3.3 | User Controls

In our application, we have implemented a well-structured menu system to group related drawing modes logically. For example, the different drawing modes for ellipses are grouped in a single dropdown menu:

Figure 3.4: Dropdown menu listing drawing options for ellipse

When a user selects a child of a dropdown menu, the icon of the drop menu is automatically updated to ensure that the user is always aware of the current drawing mode:
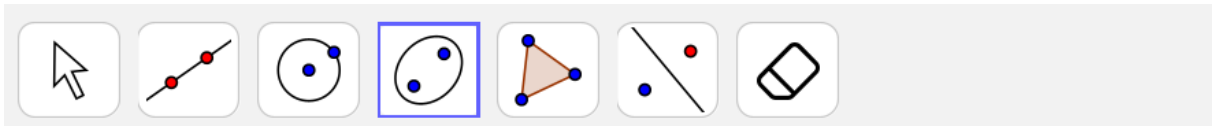
Figure 3.5: Updated menu icon for ellipse based on selected drawing option

3.4 │ Navigation

Effective navigation is crucial for ensuring that users can easily find and access the features and content they need. Our goal was to create a navigation system that is intuitive, efficient, and consistent.
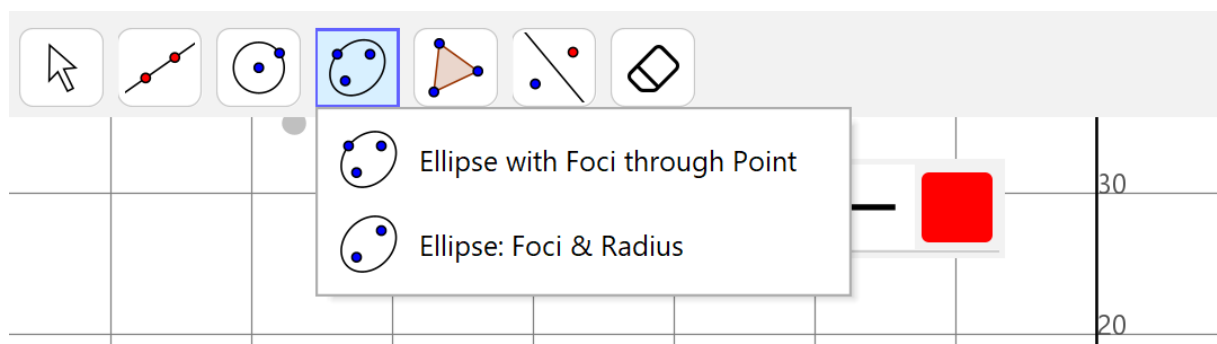
Almost all user tasks can be performed right from the main screen. For example, the top menu bar provides direct access to all drawing modes to streamline the drawing process. The only time a user needs to leave the main screen is to search and read a tutorial.

To help get a better understanding of the steps a user will take through our ap, we utilized user flow diagrams (Adobe, 2022):

Figure 3.6: User flow diagram for exporting canvas (McDonald, 2024)

Figure 3.7: User flow diagram for accessing a tutorial (McDonald, 2024)

3.5 │ Color Scheme

3.6 │ Typography

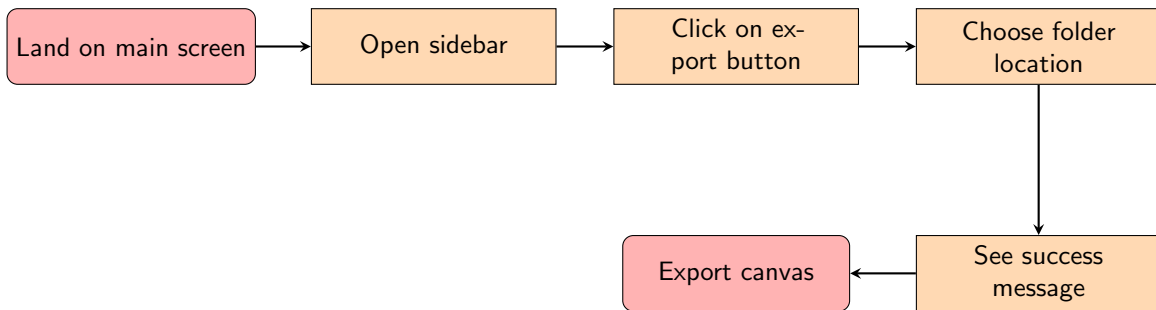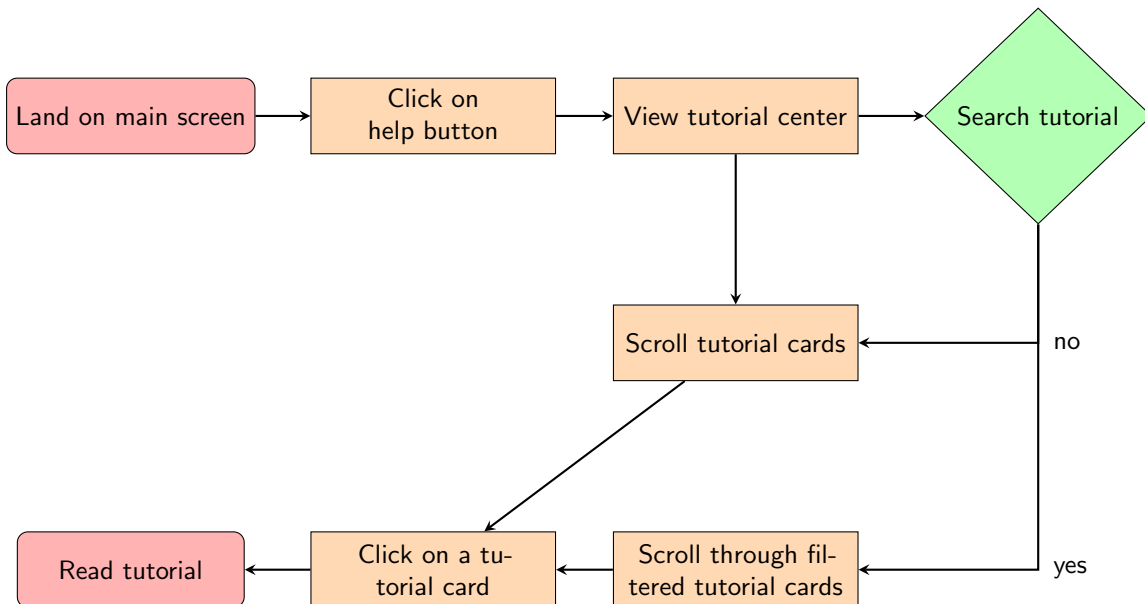Polydraw uses the system font for all text, ensuring a seamless user experience that aligns with the design language of the operating system. For example, the Segoe UI font on Windows is designed to maintain optimal legibility across sizes and pixel densities and offers a clean, light, and open aesthetic that complements the content of the system (Microsoft, 2021).

Table 3.1: System font for different operating systems

Operating System	System Font
Windows	Segoe UI
Mac	San Francisco
Ubuntu	Ubuntu Font Family

H00   Segoe UI 36 (+24 3x)

H0   Segoe UI 30 (+18 2.5x)

H1 / H1   Segoe UI Semibold 24 (+12 2x)

H2 / H2   Segoe UI Semibold 18 (+6 1.5x)

H3 / H3   Segoe UI Semibold 15 (+3 1.25x)

H4   Segoe UI 12 bold (+0 1x)

Large	Segoe UI 14 (+2 1.17x)
Default	Segoe UI 12 (+0 1x)
Medium	Segoe UI 11 (-1 0.92x)
Small	Segoe UI 10 (-2 0.83x)
Mini	Segoe UI 9 (-3 0.75x)
Monospaced	Consolas 12 (+0 1x)

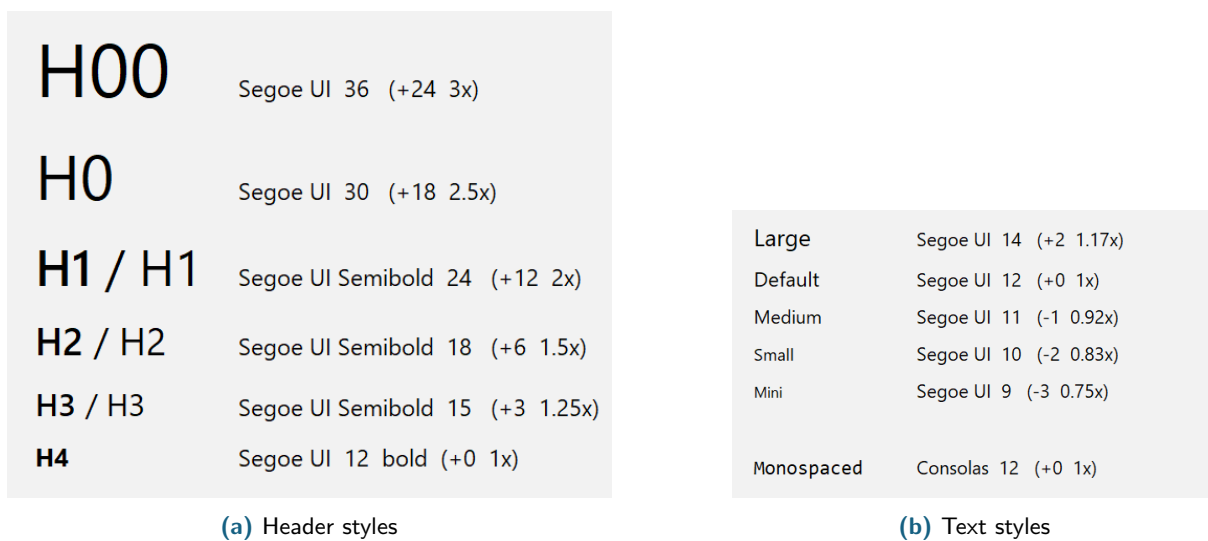**(a)** Header styles   **(b)** Text styles

Figure 3.8: FlatLaf (no date)

In the tutorials, important steps are presented with bold, larger text to draw immediate attention, while less critical instructions or additional tips are displayed in a regular font weight. This hierarchy ensures users can easily distinguish between main actions and supplementary information, improving the overall tutorial experience.
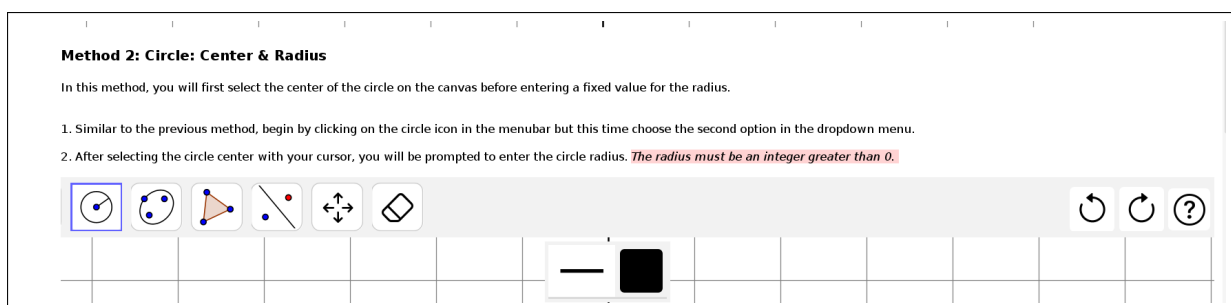
Method 2: Circle: Center & Radius

In this method, you will first select the center of the circle on the canvas before entering a fixed value for the radius.

1. Similar to the previous method, begin by clicking on the circle icon in the menubar but this time choose the second option in the dropdown menu.
2. After selecting the circle center with your cursor, you will be prompted to enter the circle radius. *The radius must be an integer greater than 0.*

Figure 3.9: Typography in circle tutorial

As seen in the above tutorial, the method title is bold and large to catch the user's attention, establishing the context of the section. Action steps are numbered and use regular font weight to maintain readability, while important notes, such as 'The radius must be an integer greater than 0,' are highlighted in italics and red to ensure they stand out and are not overlooked.

4 | Accessibility

4.1 | Responsive Design

In today's age where there can be large variations in monitor sizes and where features such as split-screen are commonplace, it is important to ensure that an application is usable in all scenarios.
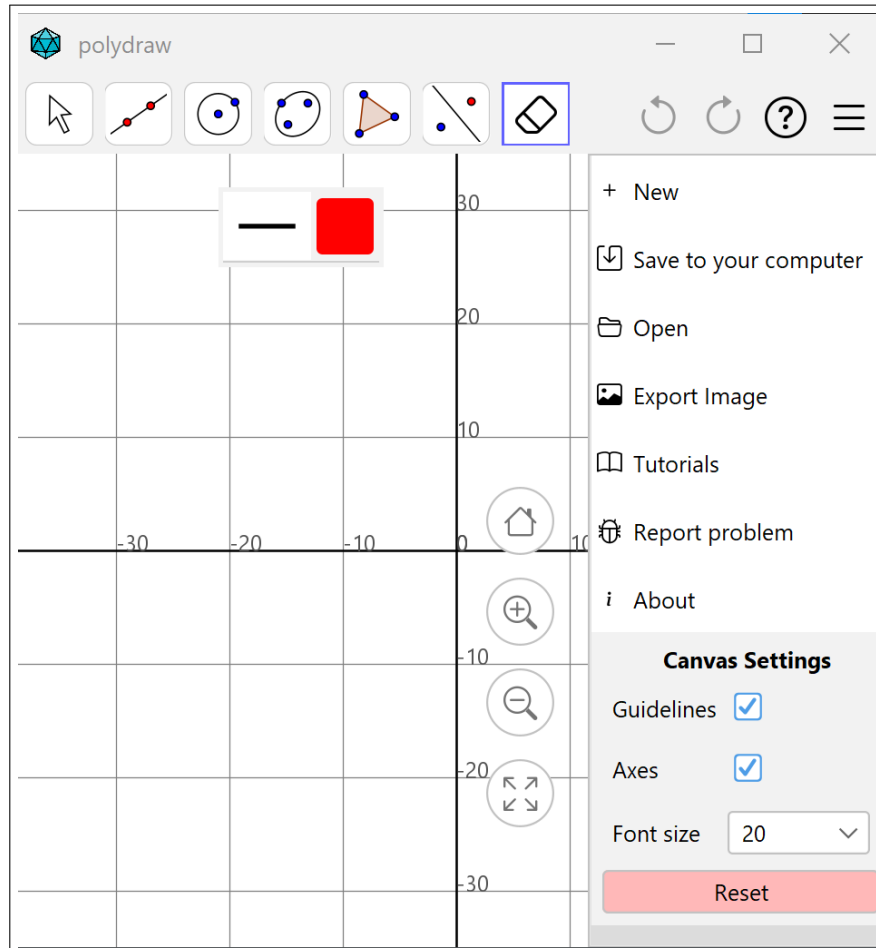

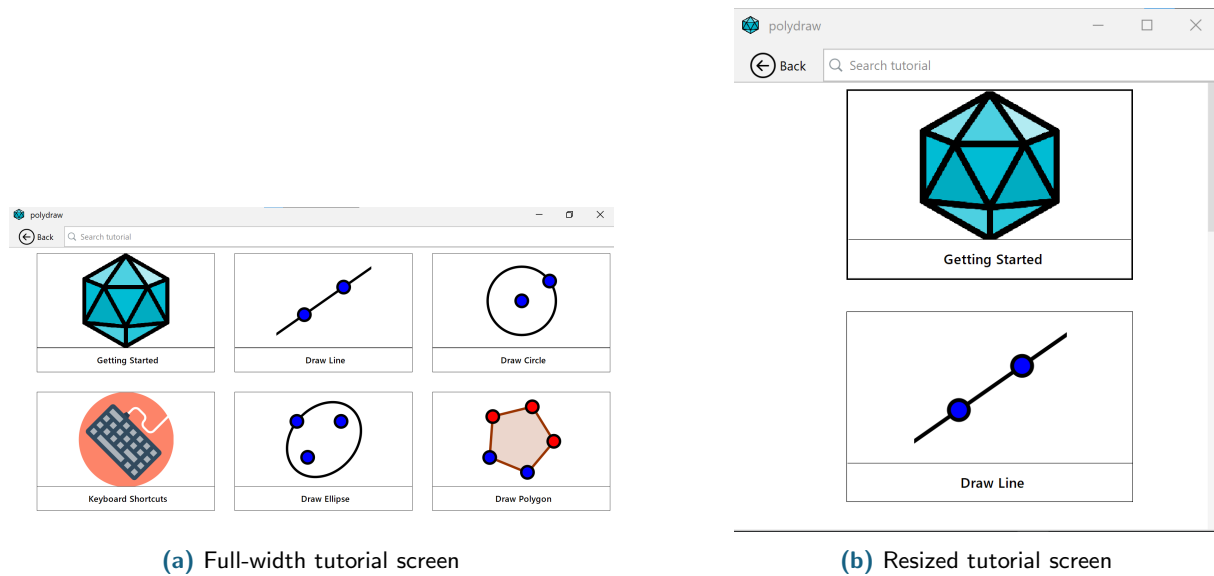**Figure 4.1:** Main screen with sidebar open on a smaller screen

(a) Full-width tutorial screen

(b) Resized tutorial screen

Figure 4.2: Responsive grid on tutorial screen

The number of columns in our help center screen changes dynamically based on the the amount of horizontal space available. For example, on a 900x900 frame, the grid has three columns, whereas on a 300x900 frame, the layout reshuffles to a one-column format.

4.2 | Keyboard Navigation

To cater to power users and improve efficiency, Polydraw allows users to use keyboard shortcuts for various actions, aligning with Nielsen's (1994) 7th heuristic on Flexibility and Efficiency of Use. Moreover, our app's keyboard shortcuts align with well-known applications such as Google Docs (no date) so that users can leverage their existing knowledge, reducing the learning curve.

Table 4.1: Keyboard shortcuts for main screen

Keyboard Shortcut	Action
CTRL + c	Copy selected shape
CTRL + v	Paste a previously copied shape
CTRL + z	Undo
CTRL + Shift + z	Redo
CTRL + Shift + s	Toggle sidebar visibility
CTRL + p	Export canvas
CTRL + +	Zoom in
CTRL + -	Zoom out
CTRL + 0	Zoom 100%
1	Select mode in cursor menu
2	Select mode in line menu
3	Select mode in circle menu
4	Select mode in ellipse menu
5	Select mode in polygon menu

4.3 | Color Contrast

All text in our app meets or exceeds the Web Content Accessibility Guidelines (W3C, 2023) minimum contrast ratio of 4.5:1 for normal text and 3:1 for large text. Adequate contrast ratios make text easier to read, reducing

eye strain and improving the overall user experience. This is particularly important for users who may struggle with low contrast settings due to age-related vision changes or other visual impairments.
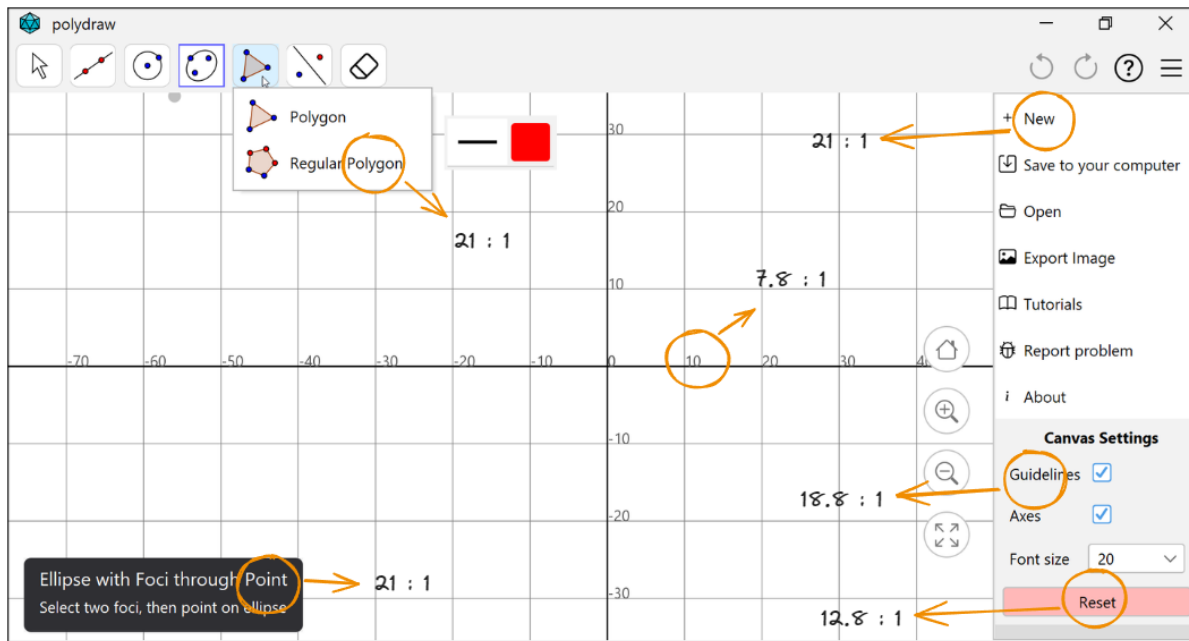

Figure 4.3: Color contrast of text on main screen as measured by Color Contrast Analyzer (The Paciello Group, 2024)

4.4 │ Error Prevention

We incorporated error prevention mechanisms by offering confirmation dialogs for critical actions and clear error messages when issues arise, in line with Nielsen's (1994) fifth guideline. For instance, before any irreversible actions (e.g., clear canvas, reset settings) are performed, a confirmation dialog with a warning message will appear.
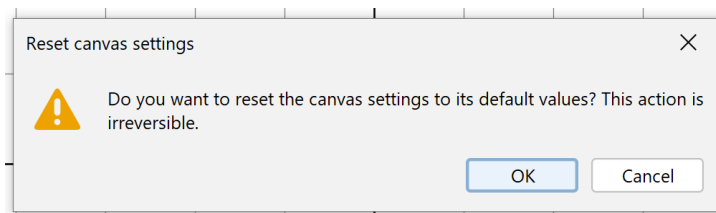
(a) Reset canvas settings dialog
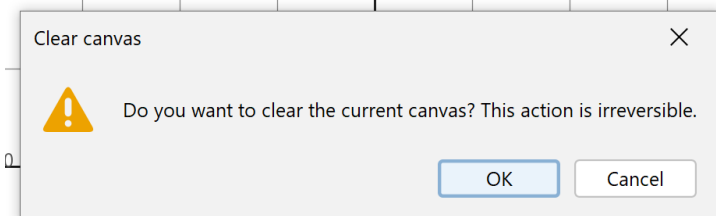
(b) Clear canvas dialog

Figure 4.4: Confirmation dialogs

Moreover, to prevent accidental data loss and ensure that users can maintain their work, the app includes a proactive feature that prompts users to save their progress when they attempt to close the application. This feature is a key aspect of error prevention, helping users avoid the common mistake of closing the app without saving their work.
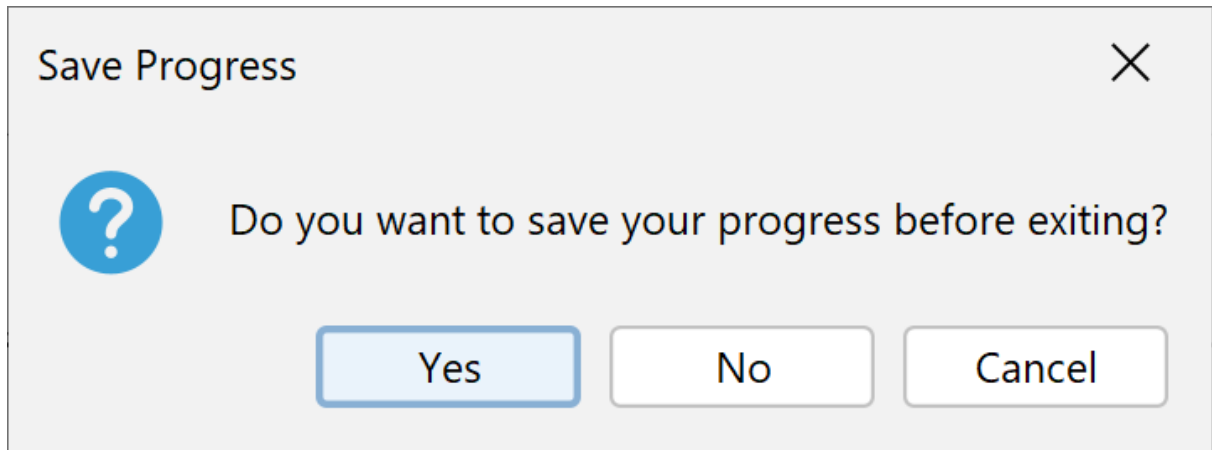
Figure 4.5: Save progress prompt

4.5 | Error Handling

In our app, error handling is designed with accessibility in mind to ensure that all users can easily identify and correct invalid inputs. Clear and descriptive error messages written in plain language are provided to guide users through resolving issues without causing frustration or confusion.
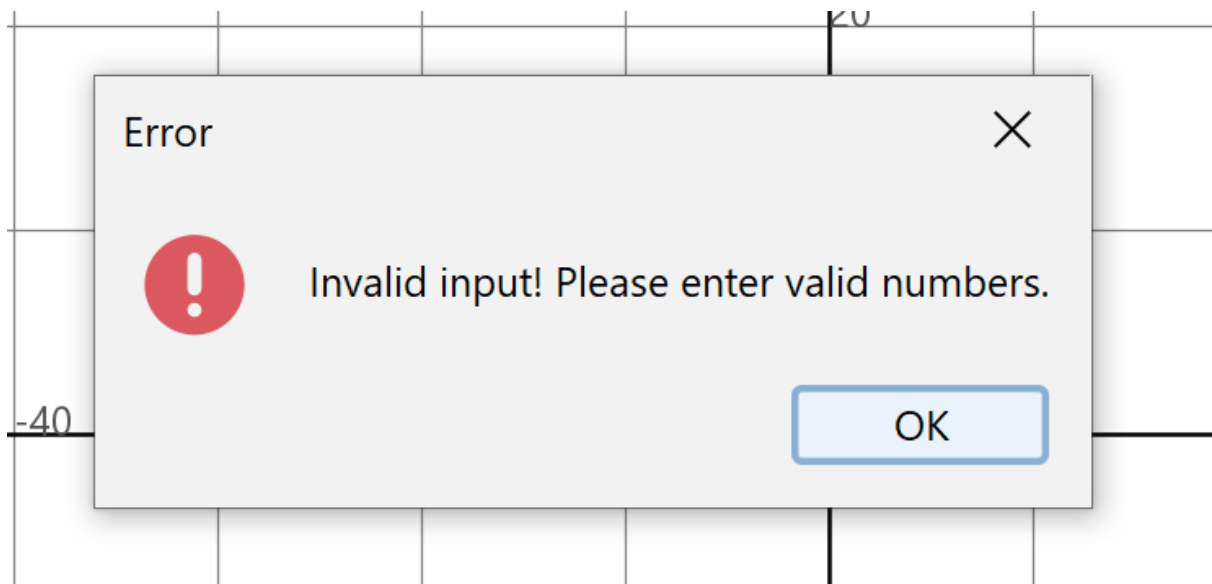

Figure 4.6: Error message when an invalid shear factor is input

5 | Help & Documentation

This section details the resources available to users for assistance with the app, aligning with Nielsen's (1994) Help and Documentation guideline. Providing comprehensive help and documentation is crucial for ensuring that users can easily find the information they need to effectively use the app.

5.1 | Contextual Help

Contextual tooltips are integrated throughout the app, providing instant help for specific features when users hover over icons or buttons.
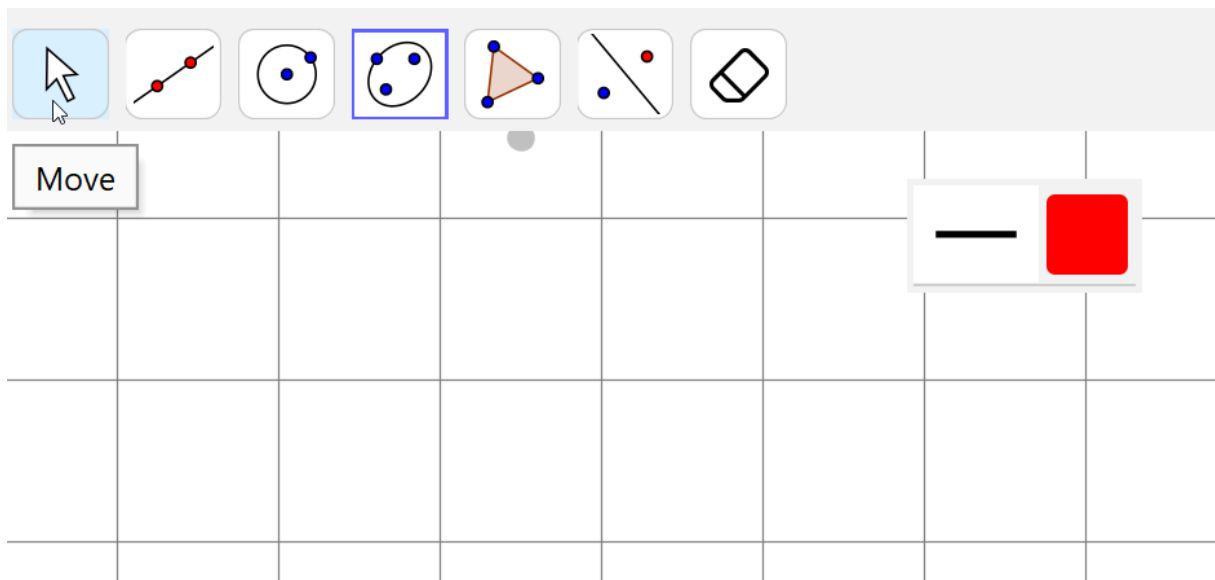

Figure 5.1: Tooltip for cursor menu

When a user clicks on a menu to change the drawing mode or hovers his mouse on a menu item, a toast component is temporarily displayed at the bottom left corner of the canvas with a quick instruction on how to proceed. This reduces the cognitive load of the user who does not have to remember the instructions for each drawing mode.

Figure 5.2: Toast component

Contextual tooltips and toast are essential because they address the Paradox of the Active User (Nielsen, 1998), where users prefer immediate action over learning through tutorials, by providing immediate guidance without disrupting workflow.

5.2 │ In-App Tutorial

The tutorial center is an integral part of our app's help and documentation system, designed to assist users in learning and utilizing the app's features efficiently. To ensure that tutorials are effective and user-friendly, we have implemented several key elements:

- **Use of interspersed screenshots and GIFs**: To provide clear, step-by-step visual guidance.

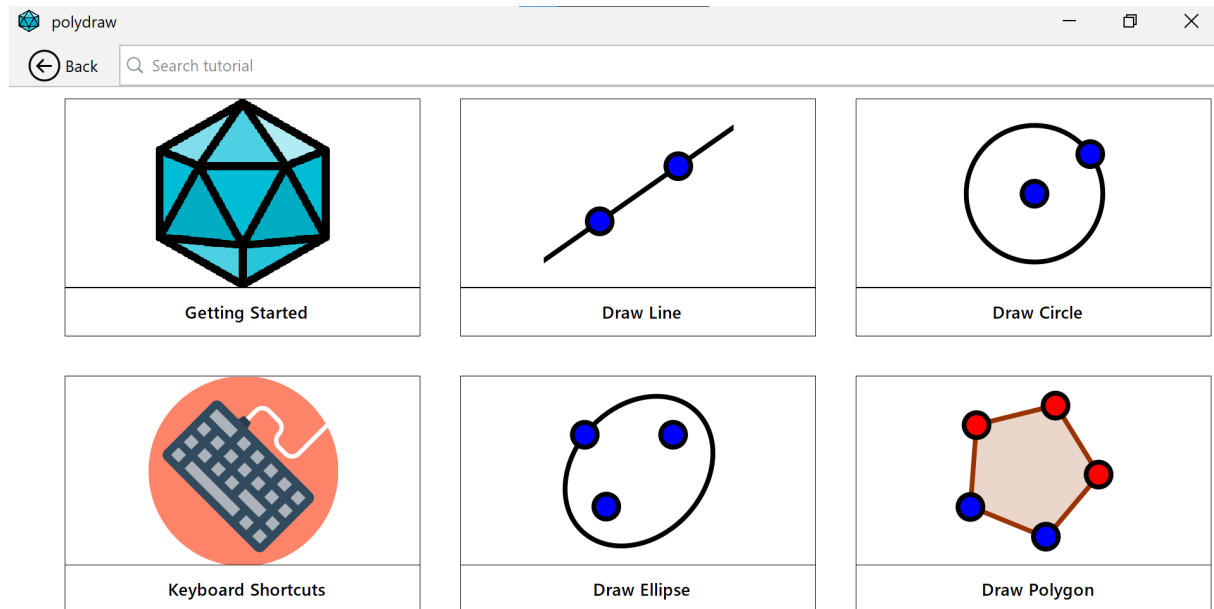- **Scannable steps**: To make tutorials easier to digest.
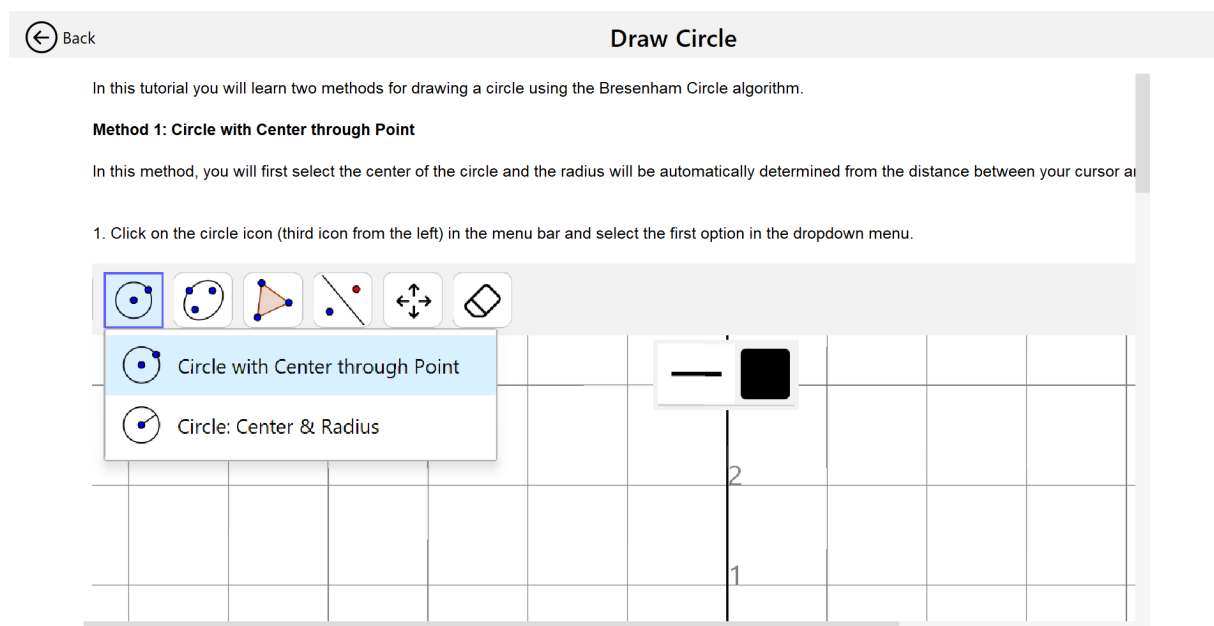
Figure 5.3: Tutorial center

Figure 5.4: Circle tutorial

The tutorial center includes a search bar, allowing users to quickly find tutorials on specific topics or features.

6 | Usability Enhancements

This section outlines the various enhancements implemented to improve the usability of our app. These enhancements are designed to make the app more intuitive, efficient, and enjoyable to use, ensuring a positive user experience.

6.1 | Transformations

Transformation tools are key usability features that allow users to modify and manipulate objects within the drawing canvas efficiently. These tools enhance flexibility, precision, and control, making the app more intuitive and accessible for users of varying skill levels.
The following transformations are available:

- Translation

- Rotation

- Scaling

- Shear

- Reflection

In our app, users can select an object and translate it by dragging it, or they can manually input horizontal and vertical translations for precision. Similarly, rotation is facilitated with an intuitive handle that allows free rotation, or users can specify an exact angle for more accurate transformations.
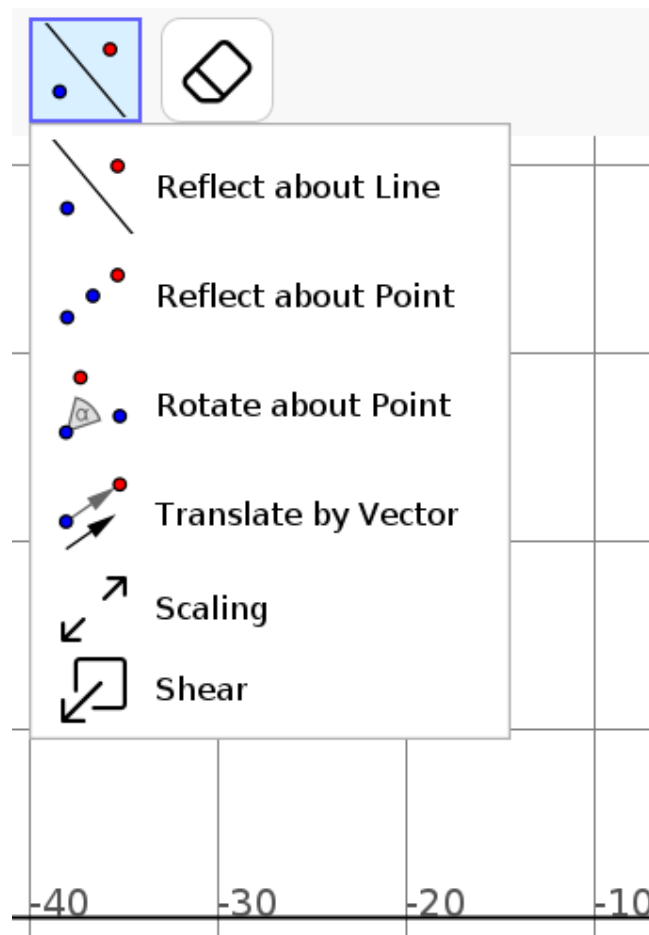

Figure 6.1: Menu with all available transformations

6.2 | Shape Clipping

The shape clipping feature allows users to remove parts of an object outside a rectangular clipping window, using the Cohen-Sutherland algorithm to determine which parts of the shape fall inside or outside the window. The user interaction workflow is as follows:

1. The user begins by selecting the top-left corner of the clipping window by clicking on a point on the canvas.

2. As the user moves the mouse, a live clipping window is dynamically drawn on the canvas, showing the area that will be clipped in real time.

3. The user finalizes the clipping area by clicking another point, marking the bottom-right corner of the window.

4. Once the clipping window is set, all shapes that lie completely outside the window are ignored, while shapes inside or intersecting the window are clipped according to the window's boundaries using the Cohen-Sutherland algorithm.
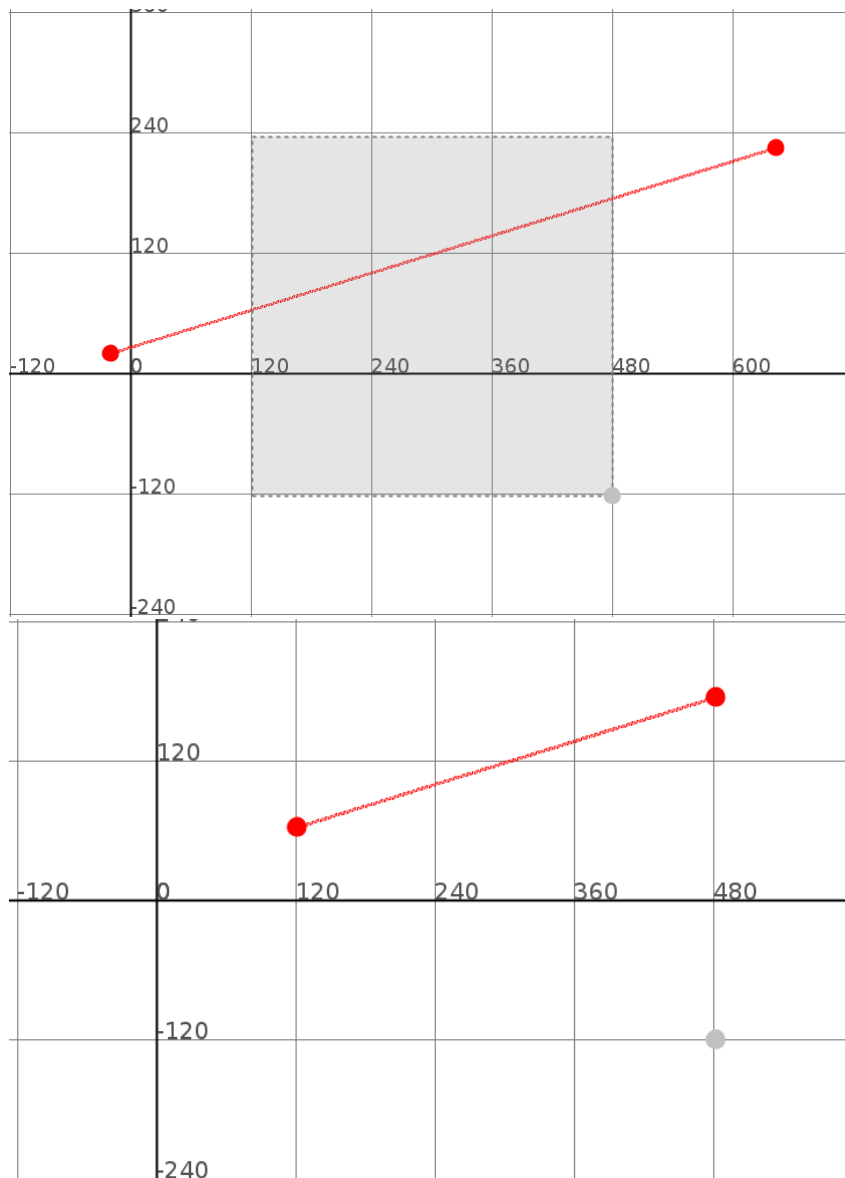

Figure 6.2: Line clipping process

Shape clipping allows users to create complex designs and artistic effects by removing unwanted parts of shapes. This creative freedom encourages experimentation and innovation, enabling users to achieve unique visual outcomes without altering the original shapes permanently.

6.3 | Animations

We used animations in some parts of our application as a form of feedback that an action has been recognized by the system (Laubheimer, 2020). An example is the animation of our sidebar menu sliding to the left when the hamburger icon is tapped. Because our visual systems are so attuned to motion, a short animation can ensure that users see the feedback.
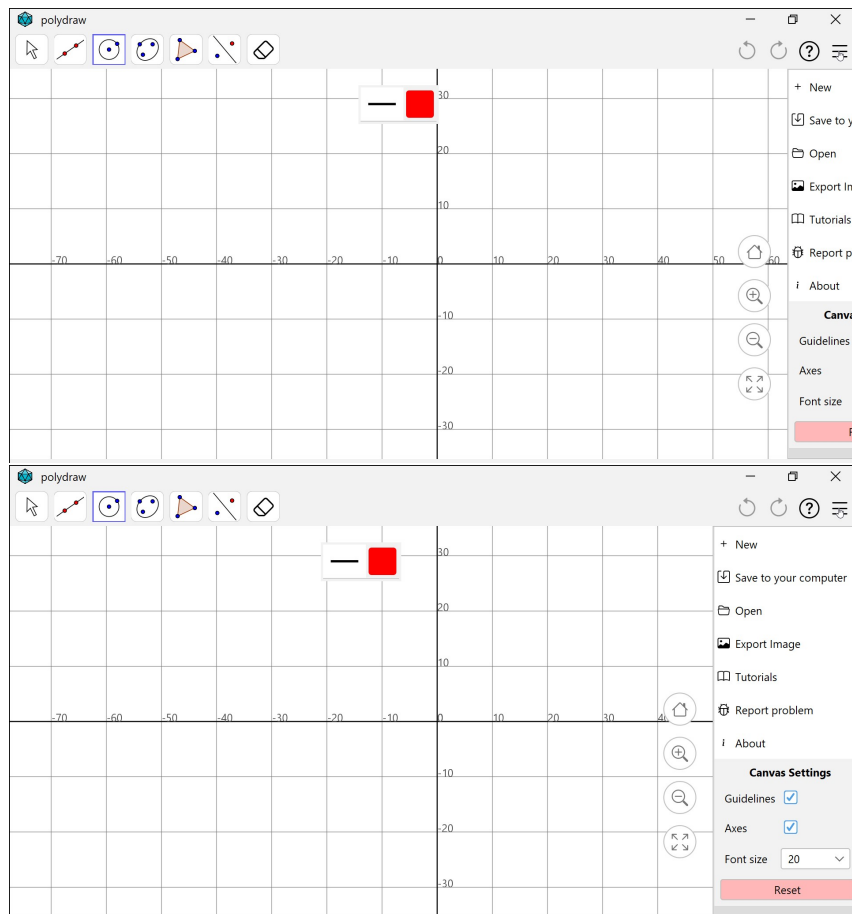

Figure 6.3: Sidebar during opening animation

Animations are also used when a transformation such as rotation and translation is applied on a shape. Gradually rotating a shape rather than instantly changing its orientation provides a sense of continuity. This smooth transition helps users follow the action, maintaining a clear understanding of the shape's position and orientation throughout the process.
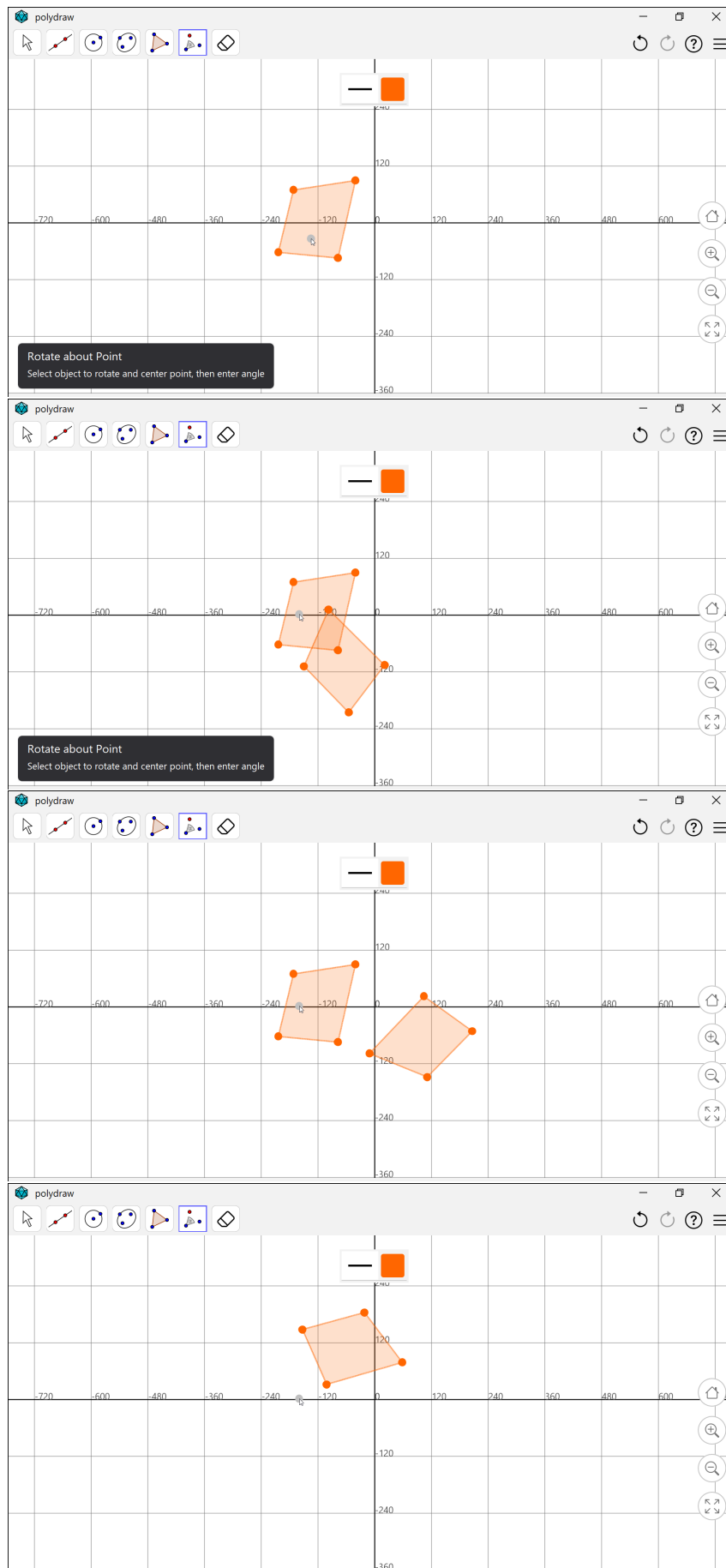
Figure 6.4: Shape during rotation animation

6.4 | Tilted Shapes

Our app includes the functionality for users to draw tilted shapes, such as regular polygons and ellipses, directly through interactive gestures. This feature is designed to provide flexibility and precision in creating various geometric forms.

In the "Ellipse with Foci through Point" mode, to create an ellipse, the user must first place the foci on the canvas by clicking. As the user moves the mouse, the ellipse will be drawn, with its tilt based on the angle between the foci and the horizontal. The size of the ellipse will change according to the mouse position.
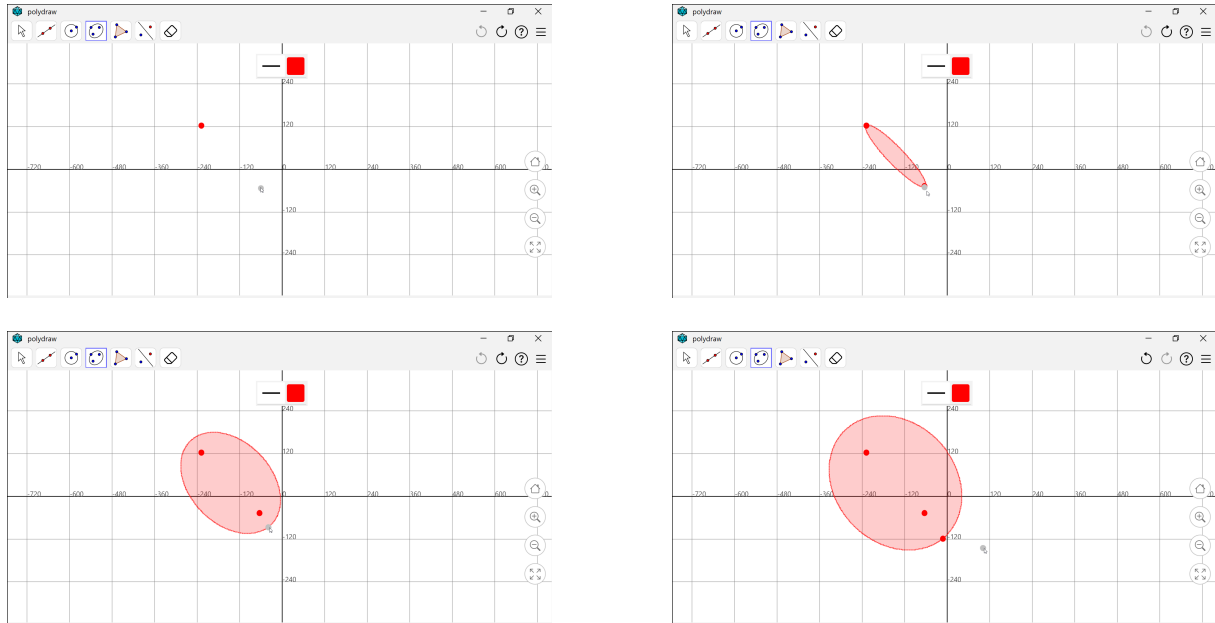

Figure 6.5: Ellipse drawing using mouse

6.5 | Shape Edit

Another fundamental feature of our application is the ability to edit attributes such as color, line thickness, line type, and position of shapes **both before and after they are drawn**.

To edit of a shape, the user needs to first switch to cursor mode and click on the shape. After selecting a shape, the shape will appear bolder and its attributes will be displayed in the toolbar from where it can be edited.
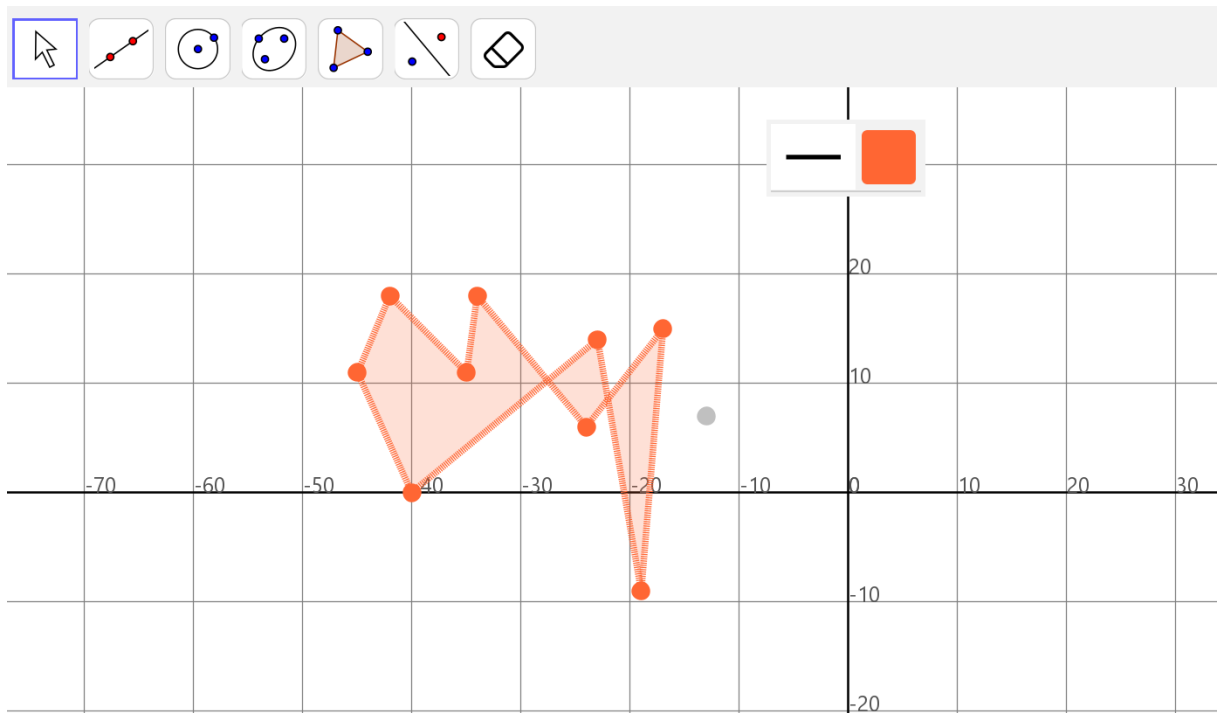
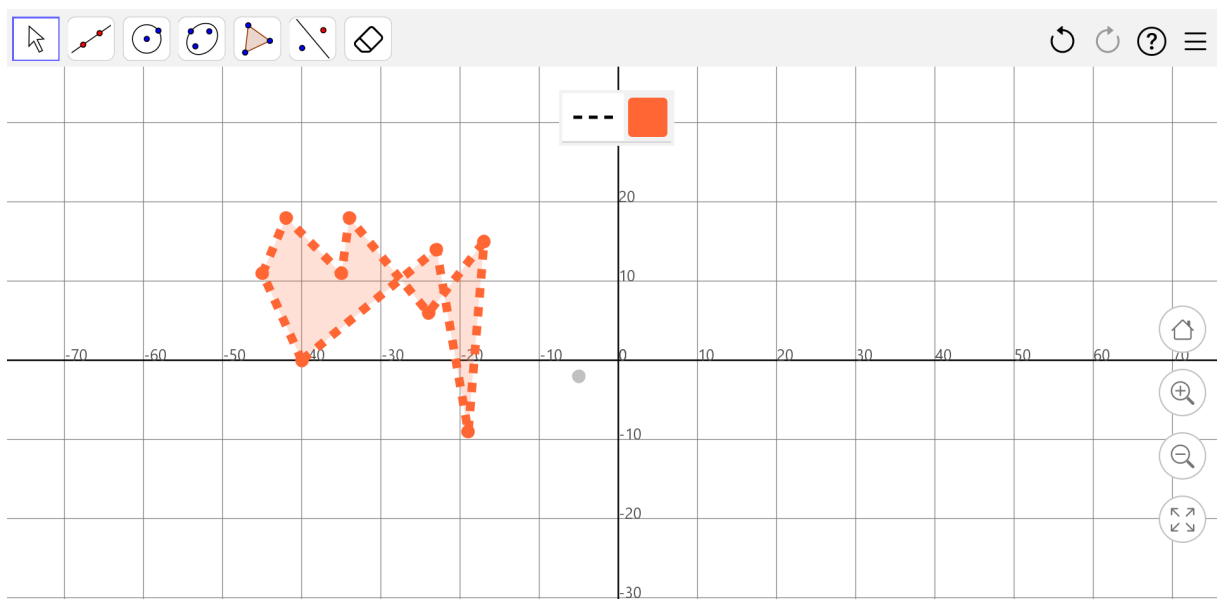**Figure 6.6:** Selected shape before editing

Figure 6.7: Selected shape after editing its thickness and line type

To translate a shape is selected, users can simply drag and drop it. To improve user experience, a live preview is displayed to provide clear and continuous feedback.
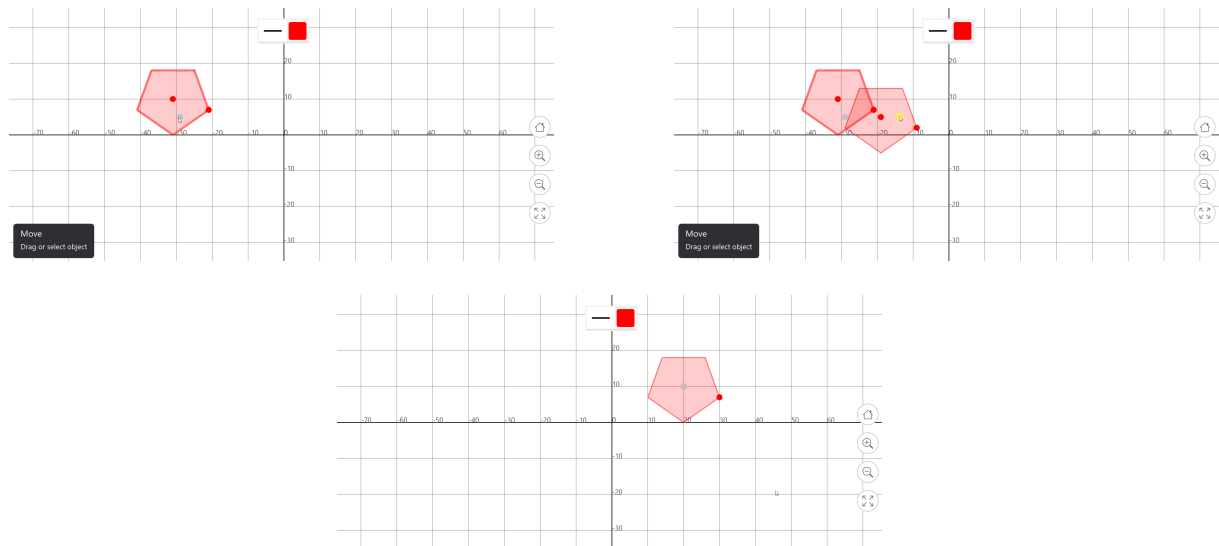
Figure 6.8: Stages during shape drag and drop

6.6 | Shape Duplication

The ability to duplicate shapes is a vital feature in our application, offering significant benefits that enhance efficiency and accuracy. Duplicating shapes eliminates the need to recreate elements from scratch, saving valuable time. Our users can quickly reproduce identical or similar shapes, streamlining their workflow and allowing them to focus on more complex tasks.

To copy a shape, the user needs to switch to cursor mode, click on the shape, and then press CTRL + C followed by CTRL + V.
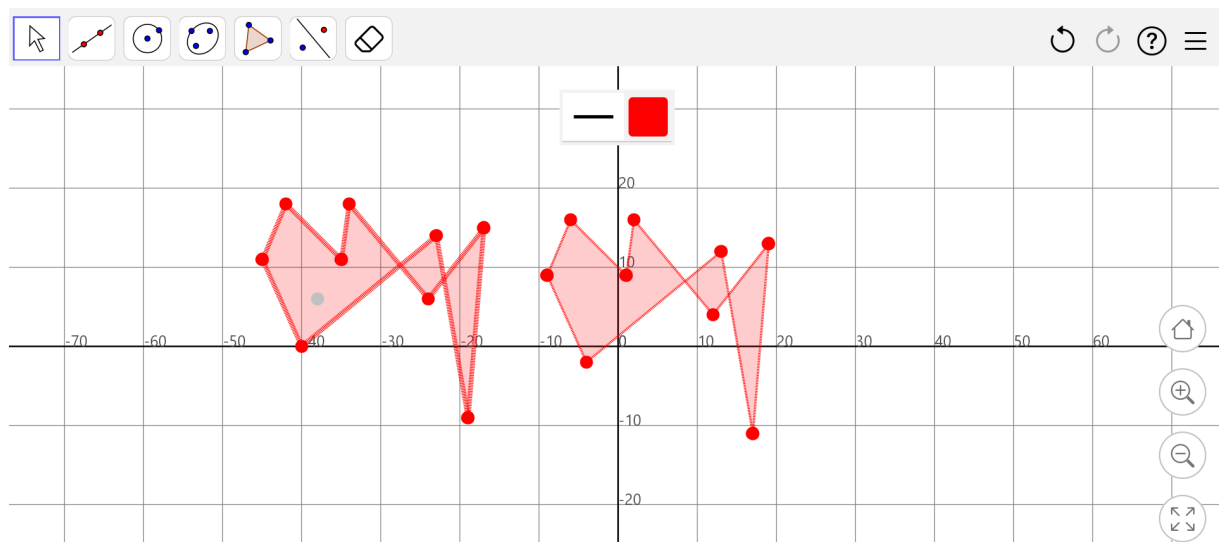

Figure 6.9: Original shape on the left and its duplicate on the right

6.7 | Canvas Import-Export

Our app enables users to save their canvas as a JSON (JavaScript Object Notation) file, which can be re-imported at any time. This usability enhancement is valuable because it provides users with a convenient way to preserve and restore their work. By allowing the export of the canvas as a JSON file, users can save their progress or share their work with others in a standardized, easily manageable format. The ability to re-import the JSON file ensures that users can pick up right where they left off or collaborate across different devices or sessions, enhancing flexibility and continuity.

To export the canvas as a file, the user must first choose the "Save to your computer" option in the sidebar after which he will be prompted to choose the folder location where the file will be saved.
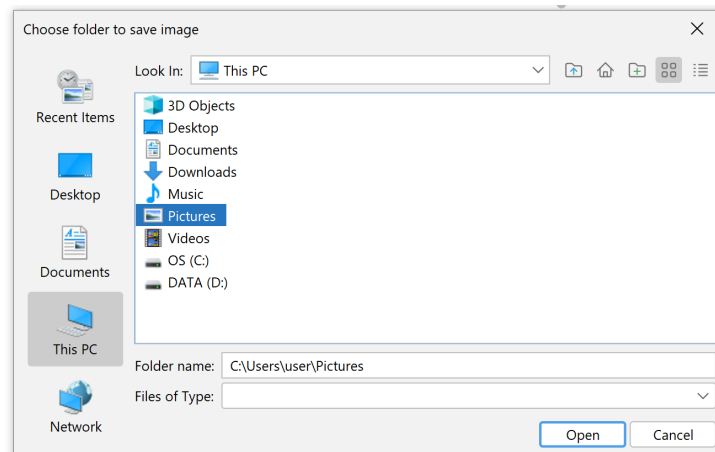

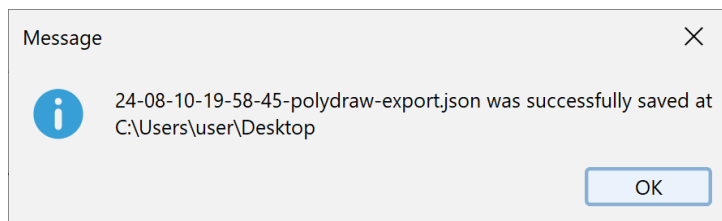**Figure 6.10:** Folder selection panel to choose JSON file location

Figure 6.11: Success message after saving a JSON file

To import a JSON file, the user needs to select the "Open" option from the sidebar and then choose the desired file. Once the JSON file is imported, the canvas will be updated with the new shapes.

An advantage of using the JSON format is that it can be used with various programming languages and tools, ensuring compatibility and ease of integration with other systems or applications.

6.8 | Canvas Drag and Zoom

The app allows users to zoom in and out the canvas as well as drag the canvas to move the viewport. This feature provides a smooth and efficient way to navigate through different levels of detail in the drawings, enhancing the overall user interaction experience.
Zooming can be done by either scrolling the mouse wheel or using the dedicated zoom buttons in the zoom panel. The number of tick labels displayed on the the axes also adapts to the zoom level.
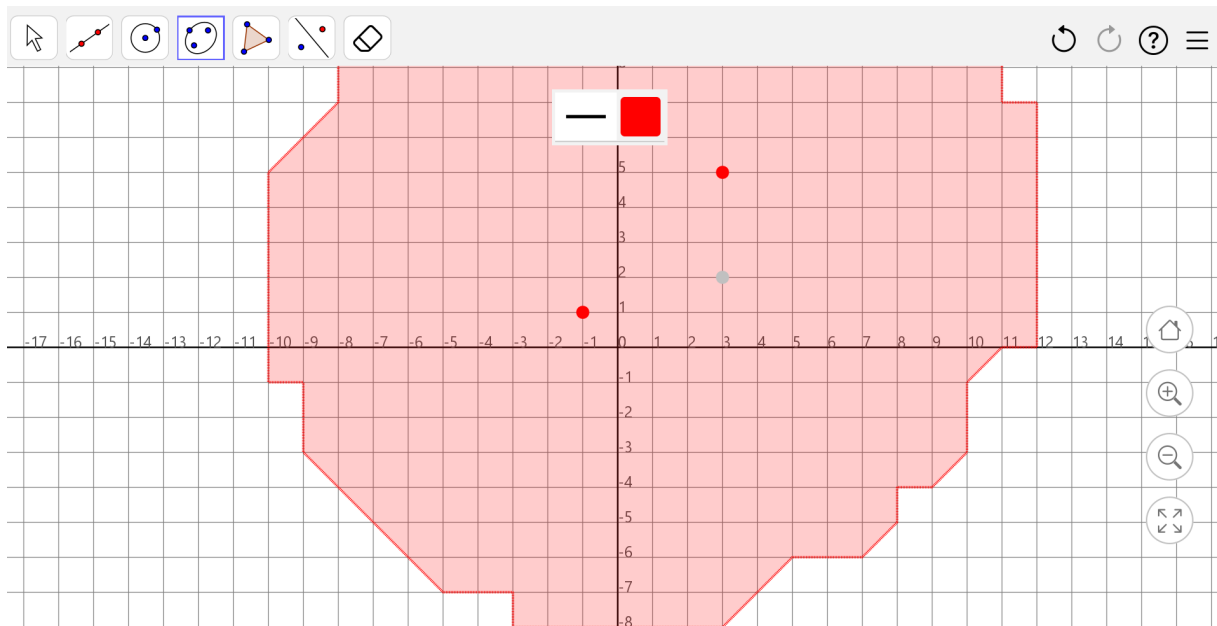
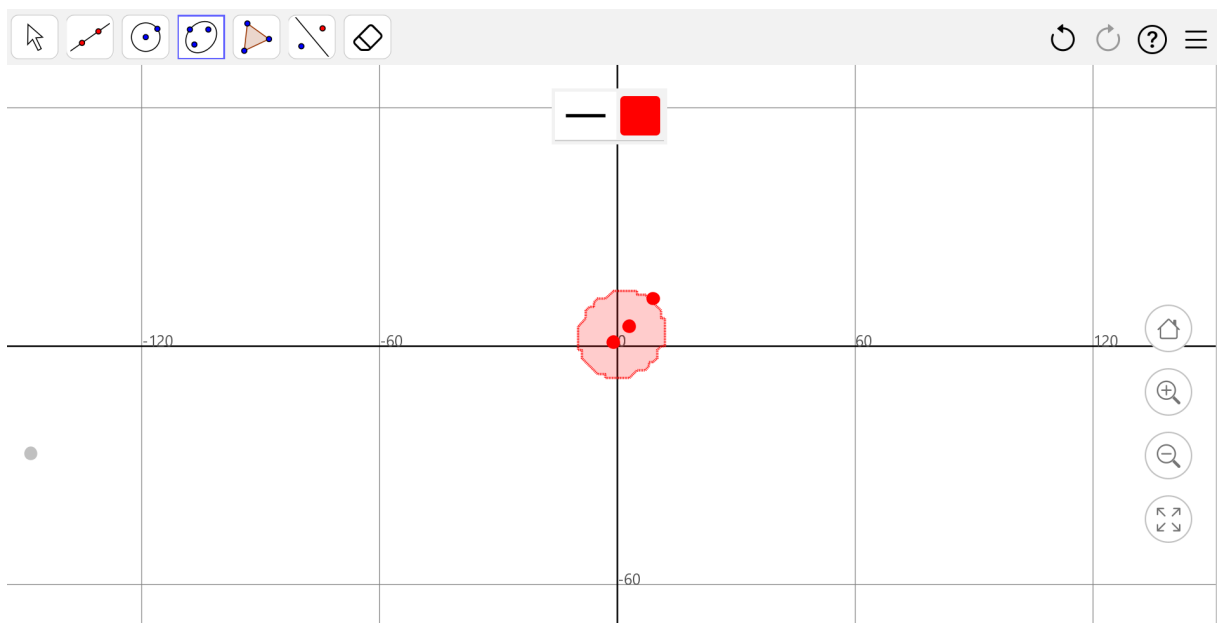**Figure 6.12:** Zoomed in canvas

Figure 6.13: Zoomed out canvas

When the axes are out of the viewport, floating axis labels will appear on the sides of the canvas so that users do not have to remember the axis labels or scroll around to find them.
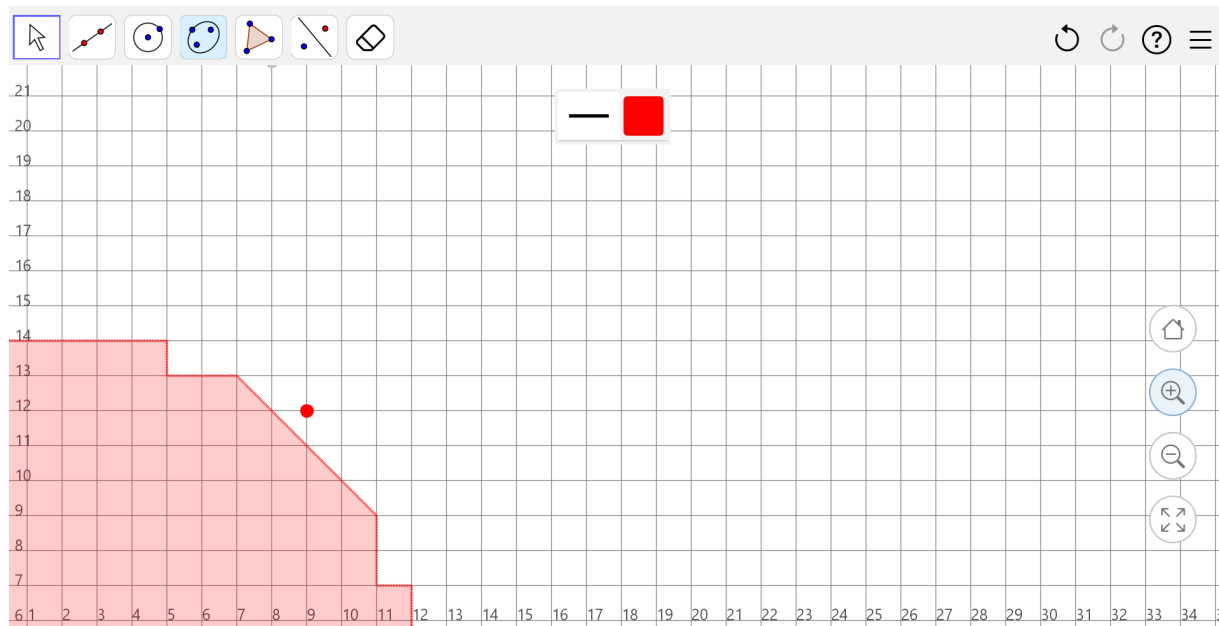
Figure 6.14: Dragged canvas

To reset the zoom level and canvas to their initial state, you can click on the button with a home icon in the zoom panel.

6.9 │ Canvas Image Export

Our app includes a robust export image feature designed to meet the needs of diverse users. This functionality is crucial for users who want to share their work or integrate it into other projects. The export image option is available in the sidebar, ensuring quick and easy access.

After clicking on the export button in the sidebar, users are asked to choose the folder location where they want their image to be saved:
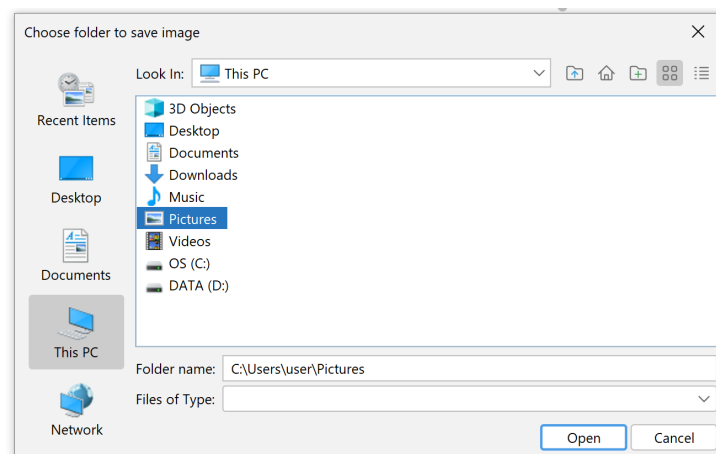

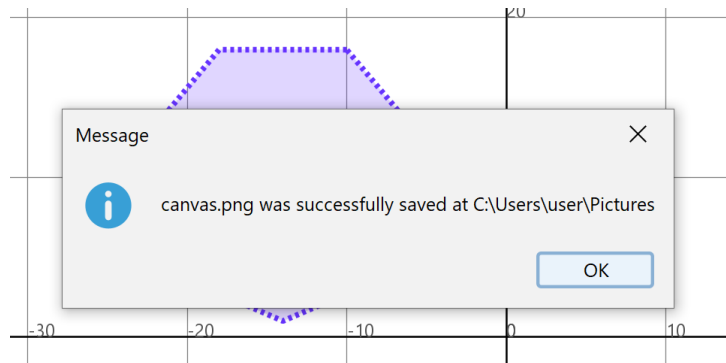**Figure 6.15:** Folder selection panel to choose image location

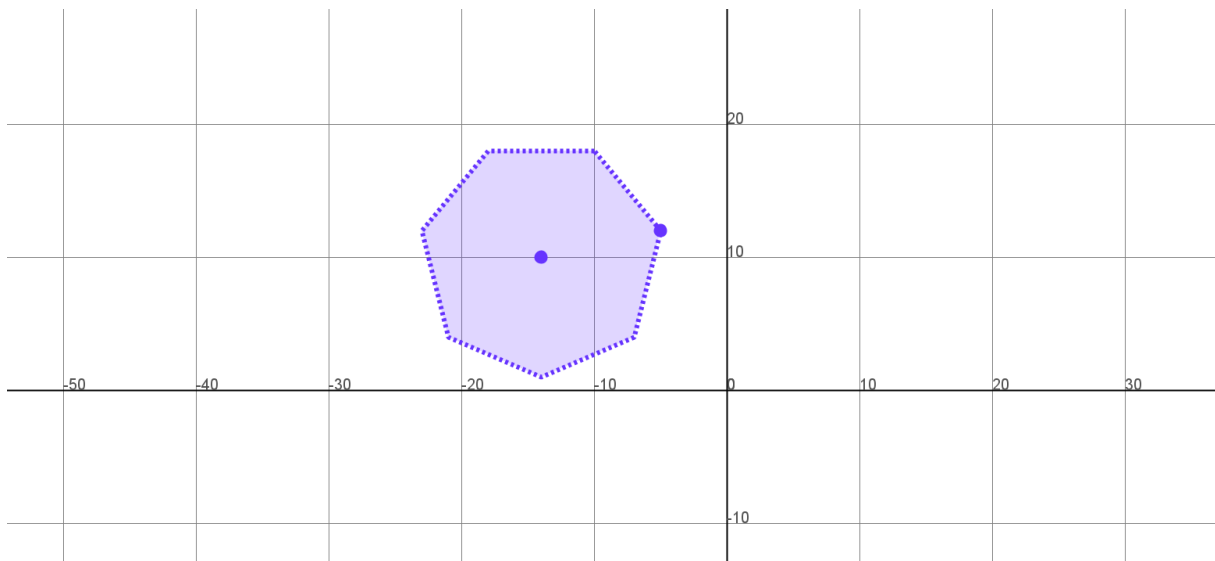**Figure 6.16:** Success message after exporting image

Figure 6.17: Exported image

6.10 │ Shape Color Palette

To enhance the user experience in our drawing application, we opted to simplify the color selection process by providing a predefined color palette. We did not want users, particularly beginners, to be overwhelmed by the multitude of color options available through HSL, RGB, and CMY models. By offering a curated selection of colors, we aimed to streamline the drawing process, allowing users to focus more on their creativity rather than getting bogged down in technical details. This approach not only makes the app more accessible but also ensures a consistent and aesthetically pleasing user interface. This decision is supported by findings from Schwartz (2004), who identified that an overabundance of choices can lead to decision paralysis and decreased user satisfaction.
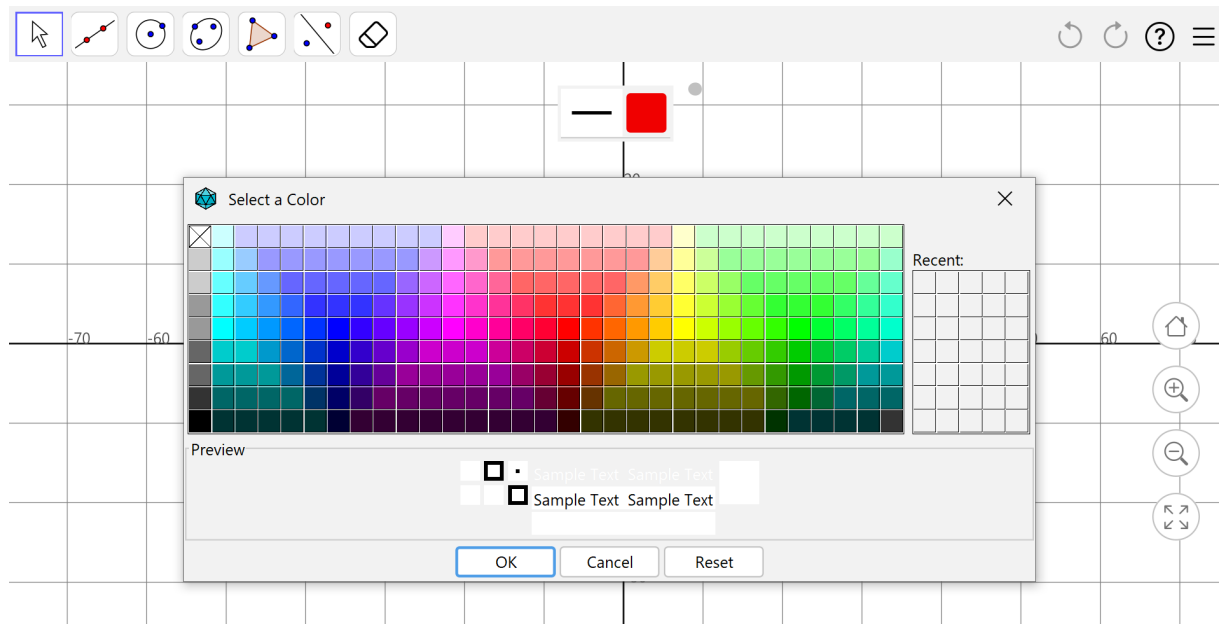
Figure 6.18: Color palette which appears after clicking on the colored box in toolbar
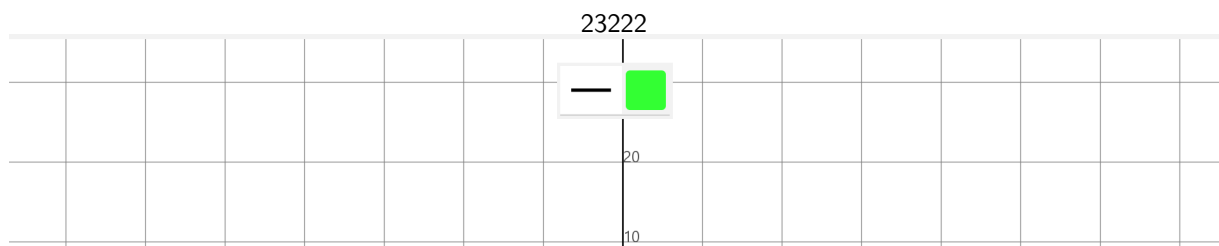

Figure 6.19: Color box after selecting the green color

6.11 │ Undo-Redo-Delete

In accordance with Nielsen's (1994) User Control and Freedom guideline, Polydraw has undo, redo, and delete buttons to allow users to easily revert their actions. This feature provides users with a safety net, encouraging exploration and reducing the fear of making mistakes.

Initially, both undo and redo buttons are disabled. When a shape is drawn for the first time, the undo button is enabled:
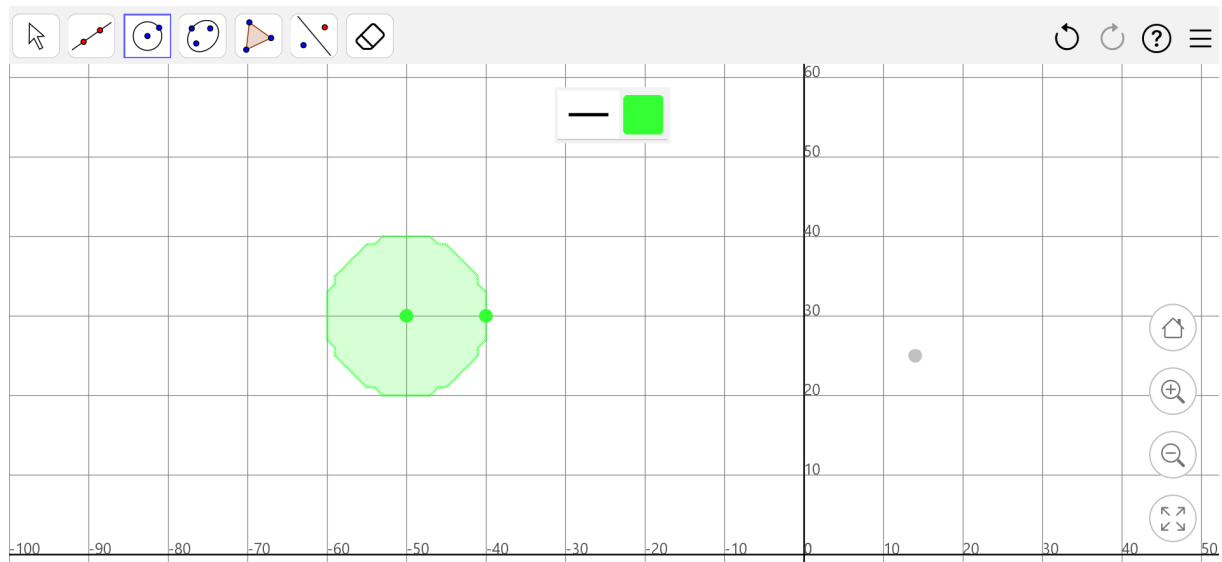
Figure 6.20: Circle drawn on an empty canvas activates undo button

When the undo button is pressed for the first time, the previously drawn shape disappears and the redo button is enabled:
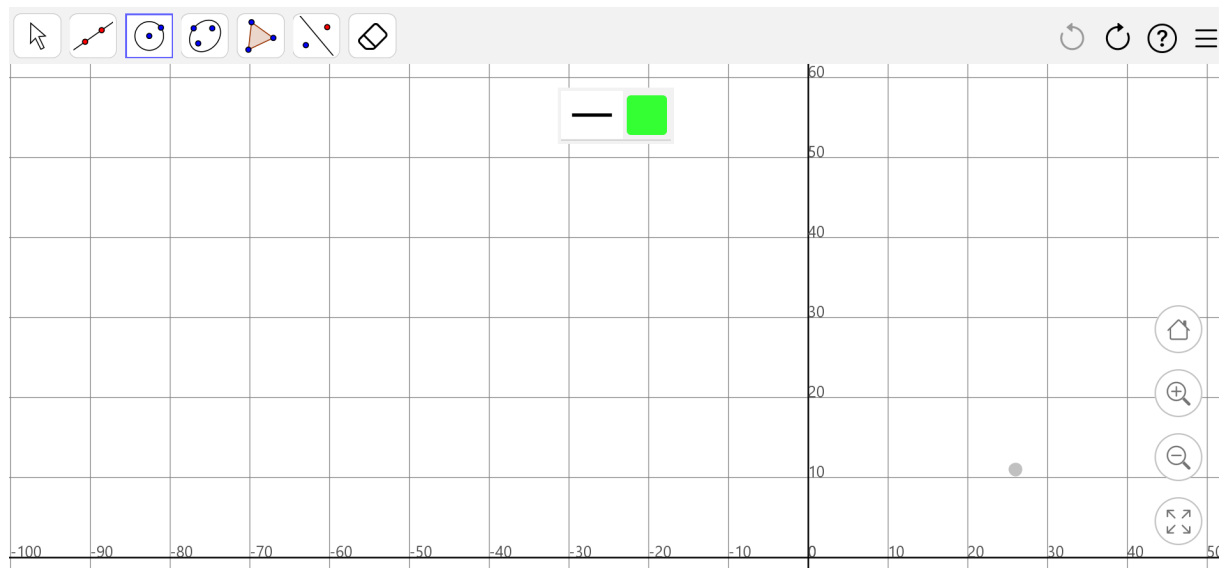

Figure 6.21: Previously drawn circle is undo-ed and redo button is activated

Currently, only the following operations can be redo/undo: create shape, delete shape, translate shape. To delete a shape, the delete mode must first be selected and a shape must be clicked on:
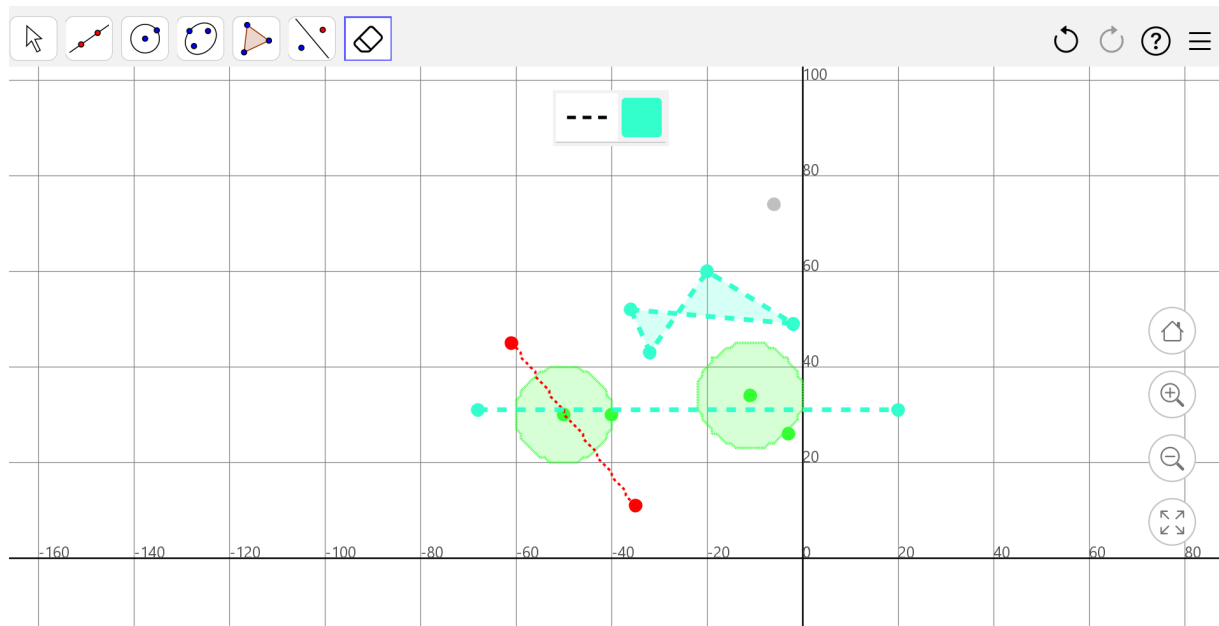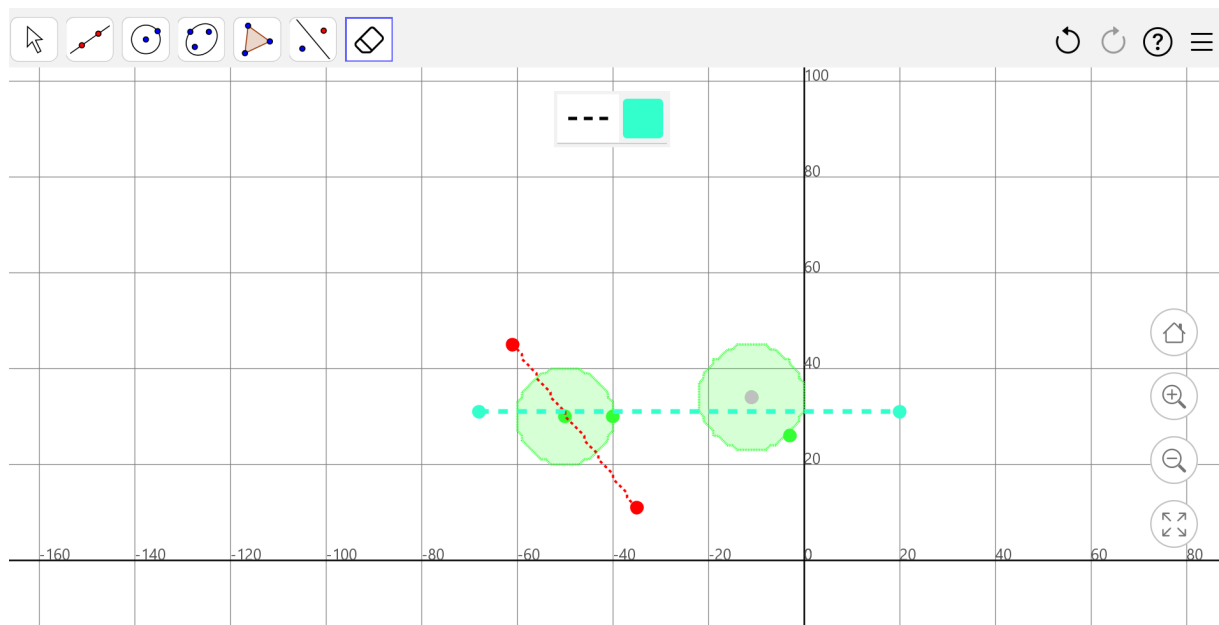
Figure 6.22: Canvas before a shape is deleted

Figure 6.23: Canvas after a specific shape is deleted

6.12 | Fuzzy Searching

To improve the search functionality within the tutorial center, we implemented fuzzy searching which allows users to find relevant results even when their search terms contain typos, misspellings, or approximate matches. The search results are also updated in real-time as characters are typed in the search bar.
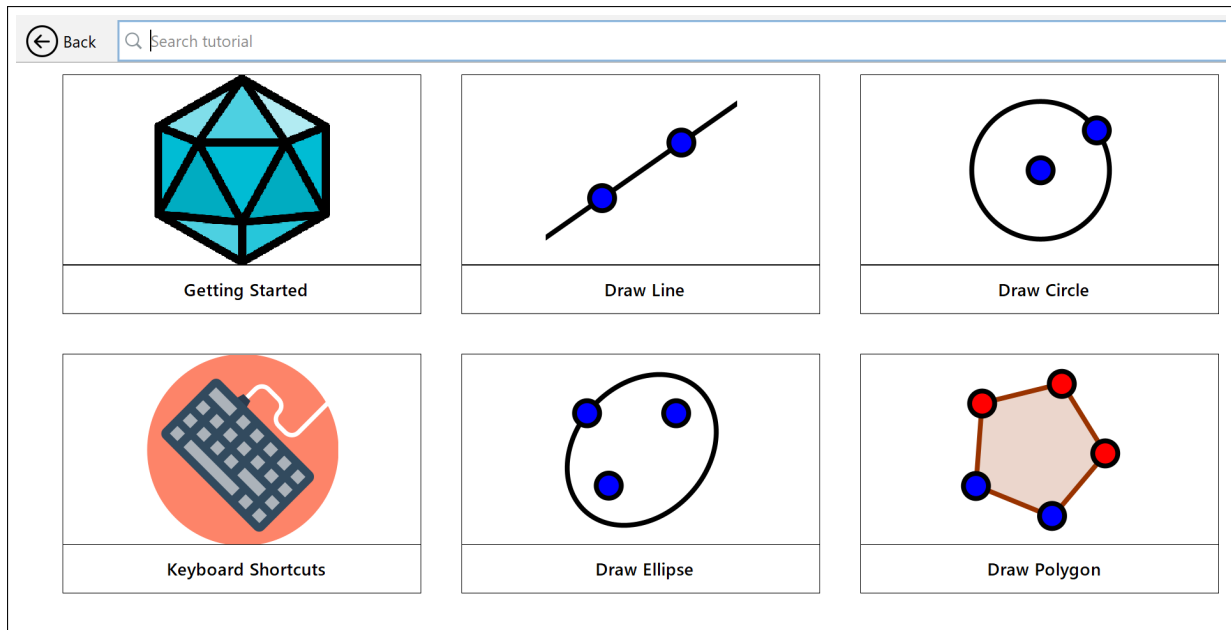
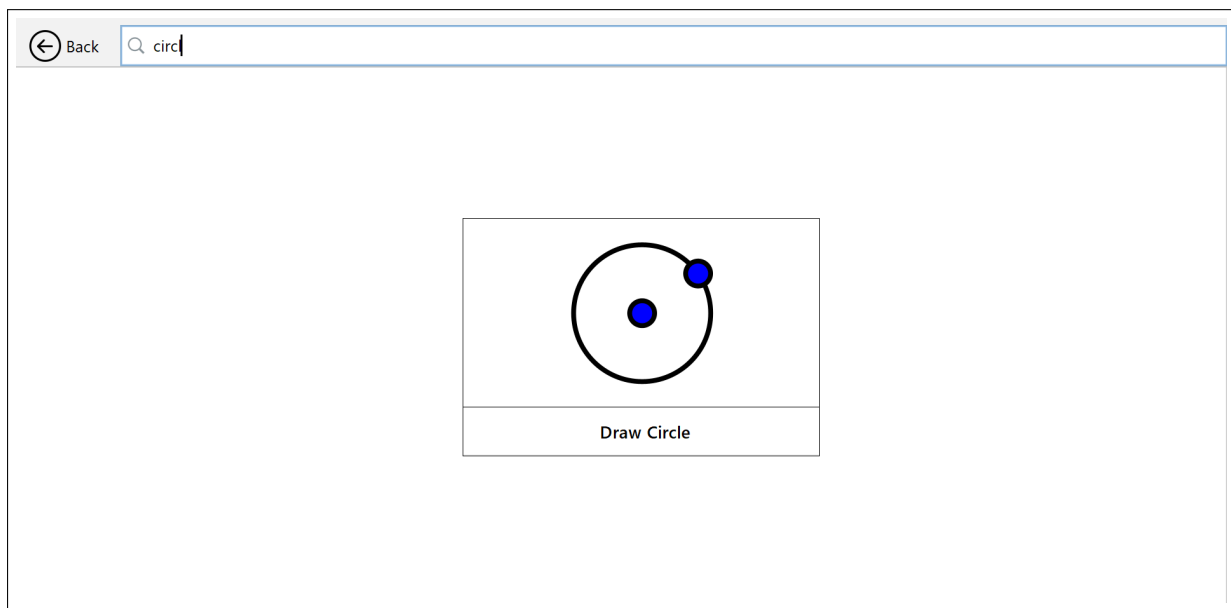**Figure 6.24:** Original tutorial center

Figure 6.25: Search results in tutorial center when "circle" is mistyped

It is also possible to search for keywords present in the tutorial. For example, since the tutorials on line and circle have "bresenham" defined as keyword, the following results appear when "bresenham" is searched:
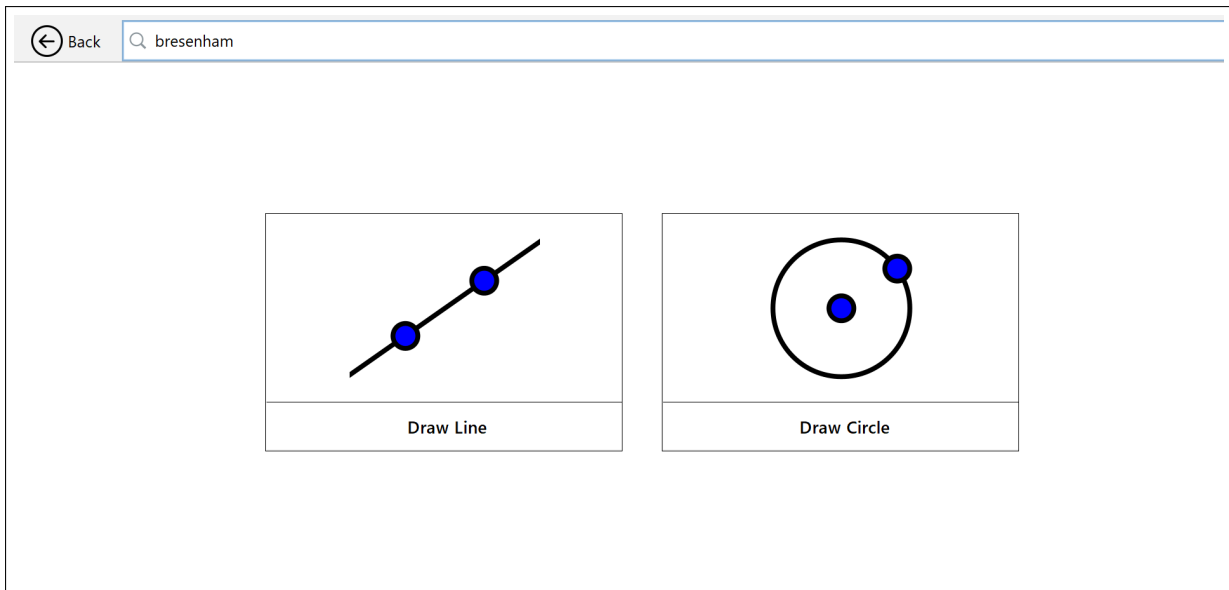
Figure 6.26: Search results in tutorial center when "bresenham" is searched

6.13 | Canvas Settings

We provided users with the ability to modify canvas settings such as the guidelines visibility, axes visibility, and label font size from the sidebar. Changes to these settings are persisted when the app is closed. By retaining user preferences, settings, and progress, persistence reduces the need for users to repeatedly configure the app every time they open it, which enhances satisfaction and loyalty.
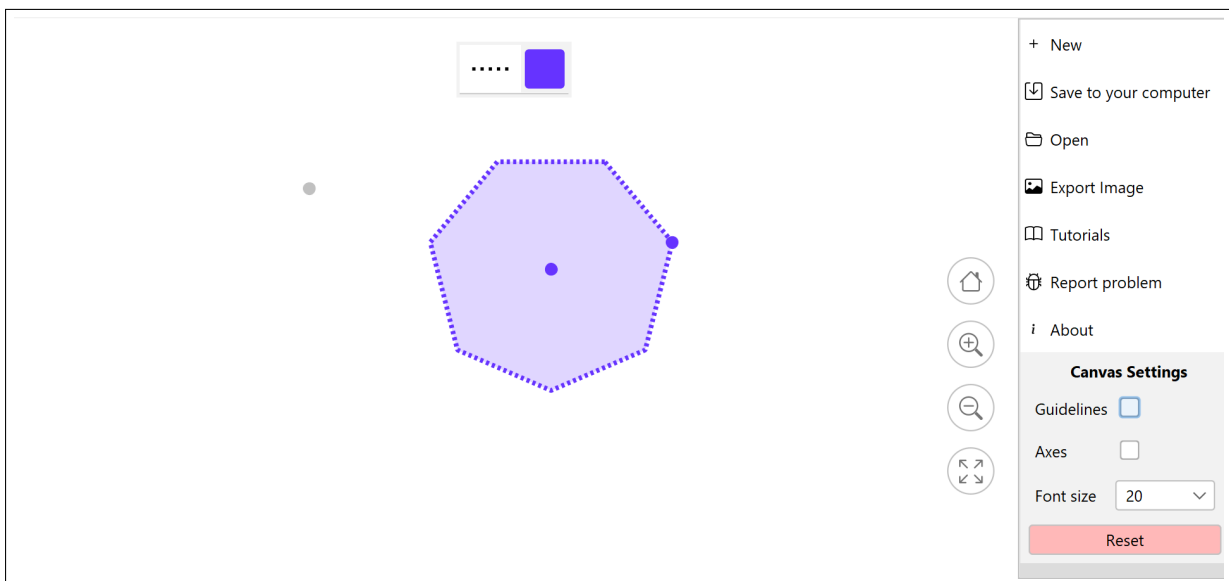

Figure 6.27: Canvas after disabling axes and guidelines

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