

Exploring the Efficacy of Tablet-based Apps and AI Tools for Creating Bitmap and Vector Print-Ready Files in Conventional Printing

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Abstract

This paper and presentation aim to explore the increasing use of tablet-based platforms and AI tools in the classroom for graphic design and the challenges that arise with producing print-ready files. The goal is to identify the strengths and limitations of these devices and apps, such as Adobe Illustrator, Adobe Photoshop, Procreate, and others on tablet apps, and AI image generation tools like popular Midjourney and Dall-E, in producing graphics for conventional printing processes. The paper will also explore possible solutions for enhancing and converting tablet-generated graphics to meet pre-press standards and provide examples of where adjustments are needed. The rise of tablet-based platforms raises the question of whether this marks the decline of traditional laptops and graphic design applications.

Background

Are tablet-generated or AI-produced digital graphics print-ready, or do they necessitate further image management for developing high-quality print-ready process color separations, tints, and spot-color jobs, including color-trapping capabilities? How can professionals encourage the proper utilization of these tools? These inquiries steer this investigation.

Observations

Recently, tablet-based raster and vector graphic design apps have gained popularity in classrooms and among students for creating print production graphics. Occasionally, students employ these robust devices and their accompanying

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styluses for crafting initial sketches and thumbnails for their projects. However, lately, tablet-based products have been covertly incorporated into print preparation workflows, lacking color trapping requirements essential for traditional print processes such as screen-printing, offset, and flexography applications. One aim is to facilitate the use of these tablet applications alongside traditional computer graphic production tools for conventional process printing. Some tablet-based graphic applications can work in both RGB and CMYK color modes [19], either in raster or vector formats, including more established Adobe products that offer scaled-down versions of Illustrator and Photoshop as part of their suite of Creative Cloud applications through their licensing [1].

Case Study

An assignment was designed as a case study to evaluate students' competencies and retention of knowledge based on previously covered coursework. This assessment aimed to establish a general baseline for their progress moving forward.

Assignment Instructions:

1. Create a poster for offset lithography using an 11"x17" vertical layout, focusing on any topic or theme.
2. Limit the design to 2 - 3 named spot colors and tints.
3. Properly create spot-color separations and apply color trapping where necessary.
4. Produce three samples of sketch work, using either pencil and paper or a tablet for generating sketches. (Note: We are exploring the potential of tablets for student work.)
5. Submit the poster as a PDF and an Adobe Illustrator native file.

After evaluating the submitted projects, it became apparent that this was an opportune moment to address their pre-existing knowledge of software usage, spot color implementation, and color trapping techniques. After reviewing the work of all 16 students, a few key insights emerged, prompting further exploration and discussion. Although most students successfully used spot colors, many struggled with creating effective color traps. Additionally, about half of the class submitted files containing elements that were difficult to interpret based on the provided native file information alone. These unique design features seemed to indicate the use of tablet applications and styluses, resulting in a more organic look compared to traditional hand-drawn sketches. This discovery led to the hypothesis that students were transferring their electronic sketches to Adobe desktop applications, such as Illustrator, to create their final submissions. The varying approaches to prepress workflow in these projects offered an ideal opportunity for a teachable moment. By addressing these observations, educators can guide students to improve their understanding of software, color management, and digital design techniques, ultimately enhancing their overall skill set. Figures 1- 5 provide some of these discoveries.

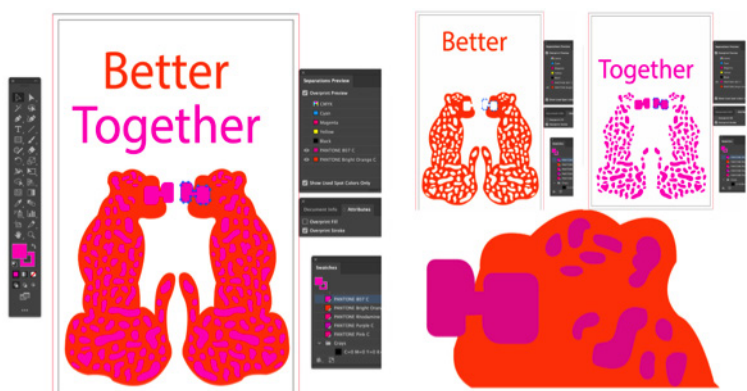


Figure 1: Example of a two-spot color submission. Spot colors named and separated in preview.



Figure 2: In reviewing for color trapping, curious applications of vectors was observed.

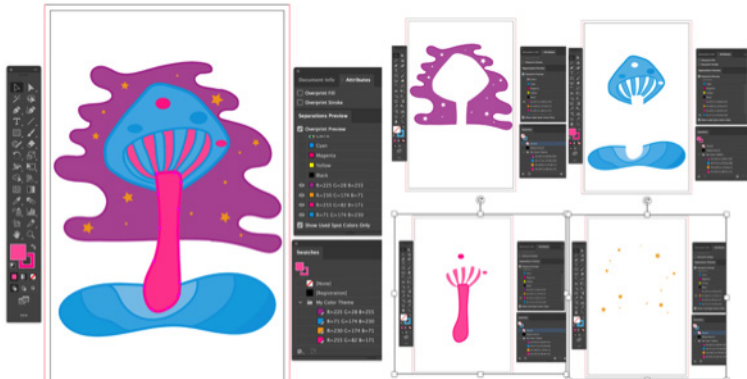


Figure 3: Another example of an artifact submission, four spot colors named and separated.

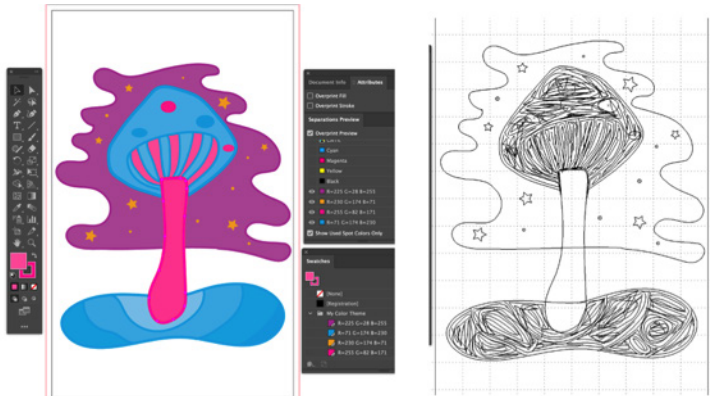


Figure 4: Another observation when reviewing color trapping discovered the curious use of vectors.

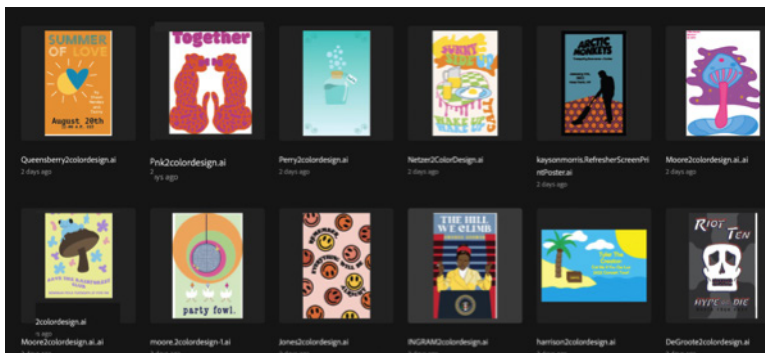


Figure 5: The discovery of many of the students' submissions had provided several curiosities regarding their design and prepress workflow that left many questions as to their development.

Teachable Moment

Upon evaluating the initial assignments, an exciting opportunity presented itself to dive deeper into the students' submissions and address potential areas for improvement, such as spot color assignment and color trapping in Illustrator. Additionally, this exploration allowed for the discovery of new techniques used by the students who submitted tablet-based graphics. Interestingly, some of these vector-based sketches were created using Adobe Illustrator for iPad, while others utilized PROCREATE, a raster-image sketching tool. Approximately half of the class employed tablet-based tools for rendering their sketches, later tracing the raster images in Adobe Illustrator on their laptops. To gain a better understanding of students' design processes and the tools they use, it was decided to introduce a writing assignment focused on their workflow. This approach would enable educators to anticipate the use of various software and tools, addressing their limitations in prepress development while simultaneously encouraging creative exploration. By emphasizing discovery and addressing workflows, this experience fosters a collaborative learning environment, empowering students to develop their skills and adapt to an ever-evolving world of design technology.

Introduction

The adoption technology theory is a framework for understanding the psychological and social factors that influence the adoption of new technologies [22]. According to Rogers (1995), individuals are more likely to adopt new technologies if they perceive them to be useful, easy to use, and compatible with their existing practices and values [22]. This theory suggests that the adoption of new technologies is a process that occurs over time, with individuals moving through various stages. Additionally, students and youth have been identified as key drivers in the early adoption of technology due to their curiosity and willingness to experiment with new technologies [12]. According to a study conducted by the International Journal of Emerging Technologies in Learning [11], “students are more likely to adopt new technologies than other groups, due to their exposure to technological advancements in their schools, colleges, and universities” [12]. As such, it is essential for educational institutions to provide the necessary resources to facilitate early adoption of technology to keep up with the rapidly changing technological landscape. By recognizing the crucial role of students and youth in the adoption of technology, educators and institutions can remain competitive in the global market [12].

Methodology

The increasing use of tablet-based platforms in the classroom for graphic design raises questions about their capabilities in producing print-ready files for conventional printing processes. This actuality proposes the question, are tablet-based platforms a viable alternative to traditional laptops and graphic design applications in producing print-ready graphics for conventional printing processes? A methodology for this objective includes:

1. Investigation of the capabilities of tablet-based platforms in comparison to traditional laptops and graphic design applications in producing print-ready graphics.
2. Analysis of the standards for producing quality pre-press files for production and the ability of tablet-based platforms to meet these standards.
3. Identification of possible solutions for enhancing and converting tablet-generated graphics to meet pre-press standards.
4. Examination of examples of where tablet-generated graphics are being produced yet need adjustments to meet the standards of outputting film for conventional printing processes.
5. Discussion of popular tablet apps, such as Procreate, Adobe Photoshop Sketch, Sketchbook, Adobe Illustrator Draw, and more, and their capabilities in producing print-ready graphics.

The findings of this research will provide insight into the strengths and limitations of tablet-based platforms in producing print-ready graphics for conventional printing

processes and identify areas for improvement. This will inform the decision-making process for graphic designers and students in choosing the appropriate tools for their projects.

iPad Pro Tablet

Apple doesn't usually release exact sales numbers for specific models of their devices, but they do report overall revenue and unit sales for their product categories in quarterly financial reports [24]. The iPad is part of the "iPad, Mac, and Wearables/Home/Accessories" category in these reports, so we don't have a way to know the exact number of iPad Pro units sold [24]. As of the end of the first quarter of 2022, Apple had sold over 450 million iPads in total, including all models of the iPad [24]. However, according to Apple's Q4 2021 financial results, the iPad had a record-breaking quarter with \$9.1 billion in revenue, which represents an increase of 21% over the same quarter in the previous year. This suggests that the iPad, including the iPad Pro, continues to be a popular device among consumers [24]. iPads have transformed digital art and design by simulating the experience of drawing on paper, thanks to SAW technology that uses ultrasonic waves for precise touch input detection. Active electrostatic (ES) stylus pens further enhance this experience with their high accuracy, passive technology, and compatibility with any device supporting pen input [11].

Surface Acoustic Wave (SAW)

In the article entitled, *Generation of Drawing Sensation by Surface Acoustic Wave Tactile Display on Graphics Tablet* by authors Amon, Akasaki, & Mizuno, in their 2012 Journal SICE Journal of Control, Measurement; and System Integration, this paper presents a pen interface that generates tactile sensations using a surface acoustic wave tactile display, allowing for the sensation of drawing with a charcoal [2]. The interface can be combined with a graphics tablet to generate both visual information and tactile sensation dynamically. The paper proposes a method of controlling the sensation using an m-sequence random number and presents measurement and FFT analysis results of the pen vibration with and without this control [2].

Styluses – Pressure Curves and Sensitivity Settings

A capacitive stylus pen uses electrostatic charge to create a stylus tip that can be used on *capacitive touch screens*. The tip of the pen is made of a conductive material, such as metal, that can hold a charge. When the tip of the pen touches the screen, the charge is transferred to the screen, which allows the user to interact with the screen. An active ES stylus is a pen that senses the capacitance of an object in front of it by using an *electrostatic capacitive stylus tip*. As a result of this capacitance, the pen's movement can be controlled. There is no need for power to operate the pen because

the technology is passive. That means that it can be used on any device with a pen input, including a computer, phone, or tablet [11].

Tablets vs laptops

Tablet computers are not completely replacing standard laptops and desktop computers, as each has its own specific use case and advantages [9]. Tablets are generally more portable, have longer battery life, and are better for consuming media, while laptops and desktops offer more power, storage, and are better for productivity tasks [25]. However, tablets have come a long way in terms of computing power and can perform many tasks that were once only possible on laptops and desktops. For example, high-end tablets such as the iPad Pro can handle tasks like video editing, graphic design, and even programming [26]. According to a report by Statista, global tablet shipments have been declining in recent years, while desktop and laptop shipments have remained relatively stable. However, this does not necessarily indicate that tablets are being completely replaced by laptops and desktops [10].

Tablet Applications

Procreate

Procreate is a graphic design app that is best used on a canvas with dimensions of 1920 x 1080px and a DPI of 72. This canvas size will give you a full screen view with an aspect ratio of 16:9 [6]. The app also requires a minimum of 4GB of RAM to function well and make the most of your canvas size and layer limit. Procreate offers over 200 handcrafted brushes, complete color control, fast performance, and various other features such as *Facepaint* [19, 20]. The industry standard for best print quality in Procreate is 300 PPI/DPI. However, depending on the printed size of your piece and the viewing distance, a lower DPI/PPI may still look acceptable. It is recommended to use no lower than 125 DPI/PPI for best results [5].

Procreate is a raster-based app [19]. Procreate is only capable of working with pixels and does not have the ability to create vector graphics, you would need to convert your lettering into a vector format using another software [19x]. Professionals use Procreate primarily for illustration, and it is considered a more affordable alternative to Adobe Photoshop [6]. Some of the benefits of Procreate include its highly responsive brush technology, intuitive interface with customizable tools and canvas sizes, and the ability to record videos. However, it has a steep learning curve for those without digital drawing experience and its features are optimized for use with the Apple Pencil and iPad Pro only [14x]. Procreate has a one-time fee and allows you to store the software on your device [6].

When using Procreate for printing, it is important to convert the color format from RGB to CMYK to achieve the best results. Keep in mind that some colors may

appear less vibrant in CMYK. Knowing the physical dimensions and proportions of the final product is crucial when setting up the canvas. It is also important to consider bleed for professional printing jobs. Setting the resolution to 300dpi or 600dpi when creating the canvas will ensure that the artwork contains enough detail and avoid pixelation. It is important to do this at the initial stage to maintain the quality of the image [13].

Procreate can handle the same level of resolution as other programs like Photoshop. For most printing needs, such as printing on an archival quality inkjet, Procreate is sufficient. However, for larger, higher resolution prints and four-color halftone process printing, Photoshop may be necessary. It is important for artists to educate themselves on image raster and output methods for reproducing their work. JPEG should not be used for final output as it sacrifices image quality for file size. Instead, artists should export in PNG or Procreate's PSD export option, which are lossless formats that save the image as drawn. Artists can import their work into other apps that give them control over printer settings or print directly from the iPad using AirPrint or Wi-Fi-connected printer apps [19, 20].

Adobe Illustrator on iPad

Adobe Illustrator on iPads is a powerful tool for graphic designers and students, offering a variety of capabilities for producing prepress graphics[1]. Key features include seamless integration with Adobe Creative Cloud, which allows users to access files and work across multiple devices, ensuring a smooth transition between iPad and desktop versions [1]. The app provides comprehensive vector drawing and editing tools for creating precise, scalable graphics suitable for prepress applications [1]. It supports both RGB and CMYK color modes, adheres to industry standards for color management, and offers robust layer management capabilities for efficient organization and control of designs [1]. Adobe Illustrator on iPads also provides various export options, such as PDF and native Illustrator formats, which are commonly used in prepress workflows [1]. Compatibility with Apple Pencil enables users to sketch and create graphics with precision and ease, like traditional pencil and paper methods [6]. Adobe consistently updates and enhances the app, ensuring access to the latest features and tools for prepress graphic creation [1]. However, it is important to note that some features may be limited compared to the desktop version [1]. Despite this, the iPad version remains a valuable tool for creating and editing graphics on the go, supporting the development of print-ready designs [1]. Below in Figure 6 and 7 outlines some of the attributes of Adobe Illustrator on iPads.

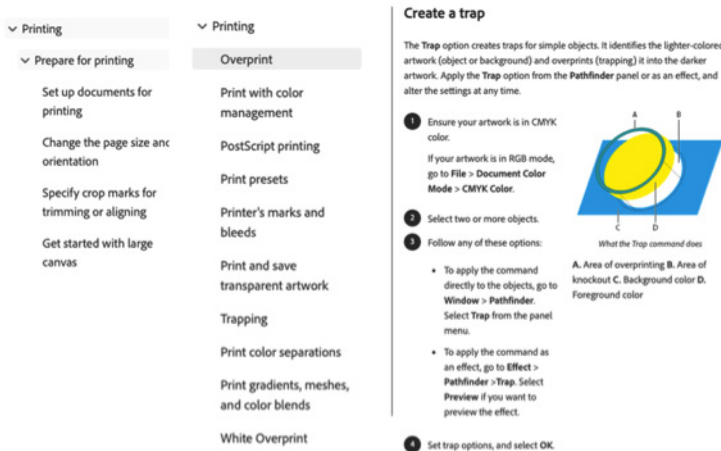


Figure 6: Printing attributes and abilities to create a color trap on the Adobe Illustrator on iPads.

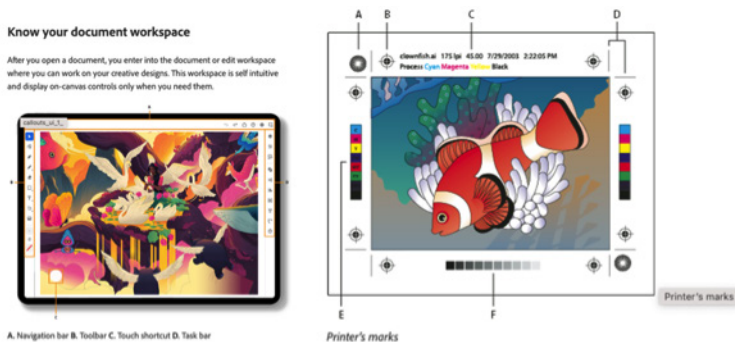


Figure 7: Adobe Illustrator on iPads' interface and functions differ from those of the desktop application and presents a dissimilar learning curve to master.

Transitioning from the desktop Adobe Illustrator to the iPad version may be challenging due to the touch-based interface. However, the familiar core features and tools, along with Adobe's efforts to maintain consistency, make adaptation easier. Resources like tutorials and guides, as well as Apple Pencil compatibility, help users become comfortable with the iPad version. Over time, proficiency increases, allowing users to effectively utilize the app for creating prepress graphics and other design projects.

Procreate vs. Illustrator

Procreate and Illustrator are distinct design software programs catering to different creative needs. Procreate excels in digital art and illustrations, while Illustrator is better suited for graphic design and complex designs [20]. Illustrator is more expensive and creates infinitely scalable vector images, while Procreate, exclusive to iPads and iPhones, produces raster images [14]. Although Procreate has a simpler interface, Illustrator's complexity can overwhelm beginners. The choice between the

two depends on personal preferences and the specific design work, with Illustrator being superior in graphic design and Procreate excelling in life-like artmaking [1].

Artificial Intelligence

Artificial intelligence (AI) is a rapidly evolving field of computer science that focuses on developing intelligent machines capable of performing tasks that typically require human intelligence [27]. It encompasses various subfields, including machine learning, natural language processing, computer vision, and robotics [27]. AI systems are designed to learn from data, adapt to new inputs, and perform human-like tasks such as problem-solving, pattern recognition, and decision-making [27]. The development of AI has revolutionized numerous industries, from healthcare to finance, enabling machines to assist humans in various tasks and significantly improve efficiency and productivity [27]. As AI continues to advance, it promises to further transform our world and the way we interact with technology [27].

AI Text-to-Image Generation

Text-to-image generation is a field of research that involves generating images from textual descriptions. The process of text-to-image generation involves encoding textual input into a format that can be used to generate an image [21]. One of the popular techniques used for text-to-image generation is the use of generative adversarial networks (GANs) [23]. GANs consist of two neural networks: a generator and a discriminator [23]. The generator takes in the textual input and generates an image while the discriminator evaluates the quality of the generated image. Through a process of trial and error, the generator learns to produce more realistic images [23]. Other techniques used for text-to-image generation include variational autoencoders (VAEs), attention-based models, and language-guided image synthesis. Text-to-image generation has a variety of applications, including art and design, e-commerce, and gaming [8]. However, the field is still evolving, and there are challenges to overcome in terms of generating high-quality and diverse images [21].

AI Image Generators (Identified as used by students in this research)

DALL-E (stylized as DALL·E) and DALL-E 2 are deep learning models developed by OpenAI (ChatGPT) to generate digital images from natural language descriptions, called “prompts” [7]. In early November 2022, OpenAI released DALL-E 2 as an API, allowing developers to integrate the model into their own applications [7]. Microsoft unveiled their implementation of DALL-E 2 in their Designer app and Image Creator tool included in Bing and Microsoft Edge [18]. Microsoft Confirms Its \$10 Billion Investment Into ChatGPT, Changing How Microsoft Competes With Google, Apple And Other Tech Giants [18].

Midjourney is an AI image generation tool that take inputs from a human (usually through text prompts and parameters, but also other images) and uses a machine learning algorithm trained on a huge amount of image data to produce unique images [24]. Like most machine-learning models, Midjourney can be a bit of a black box. Midjourney was founded by David Holz, co-founder of Leap Motion. It first entered open beta on July 12, 2022 [24]. However, on March 14, 2022, the discord server launched with a request to post high-quality photographs to Twitter/Reddit for system's training. Copyright AI - **The USCO initially granted the copyright** as though Midjourney were no different than other digital illustration tools [15]. The decision to reverse the copyright stems from the rule that only works created by humans can be copyrighted [15].

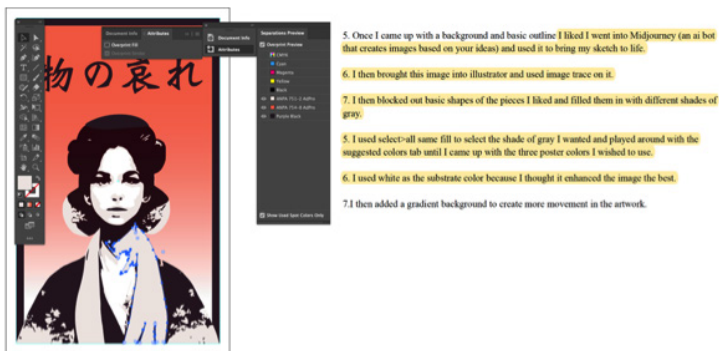


Figure 8: Student identified the use of Midjourney for ideation image generation on the assign.
The work was then process into a vector file in Illustrator.

Top Five AI image generators

Several AI-powered applications have emerged, offering a variety of functionalities and catering to different user needs. *Jasper Art* is considered the best overall AI application, providing an exceptional user experience and a wide range of features. *Canva*, an AI image editor, stands out for its ability to enhance and create visually stunning graphics with ease. For those seeking a free option, *Picsart* offers numerous editing tools and capabilities without the need for a subscription. *Photosonic* is known for its user-friendly interface, making it the easiest AI application to use for beginners and experts alike. For mobile users interested in AI-generated selfies, *Lensa AI* offers a dedicated app that delivers high-quality, realistic results. These AI applications showcase the potential of artificial intelligence to transform the way we create and interact with digital content [27].

Findings

The research examined the viability of tablet-based platforms as an alternative to traditional laptops and graphic design applications for producing print-ready graphics for conventional printing processes. It compared the capabilities of tablets to laptops, analyzed the ability of tablets to meet pre-press standards, identified

possible solutions for enhancing tablet-generated graphics, and examined instances where adjustments were needed for tablet-generated graphics to meet printing standards. Additionally, the study discussed popular tablet apps, such as Procreate, Adobe Photoshop Sketch, Sketchbook, and Adobe Illustrator Draw. The findings provided insight into the strengths and limitations of tablet-based platforms, highlighting areas for improvement, and informing decision-making for graphic designers and students in selecting appropriate tools for their projects.

Conclusion

In recent years, the adoption of tablet-based raster and vector graphic design apps in classrooms has been on the rise. Our findings shed light on the strengths and limitations of these tablet platforms in generating print-ready graphics for traditional printing processes, as well as highlighting areas for enhancement. According to Adoption Theory [22], younger adopters are more inclined to embrace new technologies if they perceive them as useful, user-friendly, and compatible with their current practices and values [12]. The integration of AI tools, design, and prepress output is likely, if not inevitable. The question of whether tablet-based platforms can serve as viable alternatives to traditional laptops and graphic design applications for graphic designers and students depends on the suitability of the tools for specific projects. Statista reports that global tablet shipments have declined from 230 million units in 2014 to 144 million units in 2020, while laptop shipments have risen from 160 million units in 2014 to 218 million units in 2020 [25]. This data suggests that laptops may be more popular than tablets for computing tasks. However, tablets maintain a substantial market presence in sectors such as education, healthcare, and retail, where their portability and ease of use are appreciated [10]. Thus, it remains uncertain whether tablets will surpass laptops and desktops in the future, as this outcome depends on various factors and market trends.

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