

Exploring Digital Toolkit Ecosystems: A Study of an Application Usage Pattern in Studio Based Design

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Abstract: *In the ever-evolving landscape of studio-based design education, the integration of digital tools and applications has become paramount. This conceptual paper delves into the dynamic realm of “Digital Toolkit Ecosystems,” presenting a visionary study that seeks to unravel the intricate web of app usage patterns within studio-based design disciplines. In an era where technology has become an indispensable facet of the creative process, understanding how emerging apps shape the learning landscape is of critical significance. The paper lays the foundation for an in-depth exploration of how these digital tools influence pedagogy and design practice in studio-based education. By conducting a comprehensive study, it endeavors to unearth usage trends, preferences, and their impact on learning outcomes. The study takes a holistic approach, considering diverse design disciplines such as architecture, interior design, and industrial design. Central to this exploration is the recognition of the symbiotic relationship between learners, educators, and the digital tools they employ. The paper envisions uncovering patterns of app adoption, utilization, and their influence on*

students' creativity, problem-solving skills, and design proficiency. The methodology incorporates qualitative and quantitative research, including surveys, interviews, and usage analytics. By examining both the macro and micro perspectives of the digital toolkit ecosystems, this study aims to provide a comprehensive understanding of their role in studio-based design education. Ultimately, this conceptual paper aspires to offer valuable insights for educators, institutions, and technology developers, driving informed decisions to enhance the integration of digital tools within studio-based design education. Through the lens of "Digital Toolkit Ecosystems," it endeavors to shape the future of design pedagogy, empowering learners to thrive in an increasingly digital and innovative world.

Keywords: *apps usages, creative workflow, design tools, design ecosystem, studio design*

1. INTRODUCTION

The evolution of design practice has been profoundly influenced by the integration of digital technologies, revolutionizing the creative landscape within studio-based design. At the core of this transformation are design apps, which have become indispensable tools for conceptualization, prototyping, and communication in the design studio. Yet, as the design app ecosystem continues to expand, it is imperative to explore the intricate landscape of their usage patterns. This research endeavors to investigate the nuanced dynamics of app usage within studio-based design, offering insights into the evolving relationship between technology and creative practice.

Drawing upon a comprehensive literature review, this study synthesizes key insights from scholars in the field. Bolter and Grusin (2000) have explored the concept of "remediation," emphasizing how new digital media reconfigure older forms and thereby offer fresh creative possibilities. This perspective contextualizes the integration of design apps within broader creative practices, where technology acts as both a canvas and a catalyst for innovation. Duffy and Nagai (2010) underscore the significance of technology integration in design processes, highlighting that designers must view technology as an integral component of their creative toolkit. This viewpoint not only underscores the evolving role of technology within the

design studio but also sets the stage for an examination of how design apps, as digital tools, intersect with and enhance the creative process.

In the realm of design education, even prior to the pandemic, there has been a consistent flow of research examining the potential integration of technological advancements. For instance, studies have explored the application of technologies like virtual reality (as noted by Bernardo & Duarte, 2022; Elvezio et al., 2017; Teklemarian et al., 2014) and the adoption of distance learning formats (as indicated by Aldoy & Evans, 2020) within higher education design programs. While these investigations are often exploratory in nature, they collectively underscore the rapid evolution and increasing accessibility of technology. Additionally, higher education institutions (HEIs) appear committed to retaining and enhancing their investments in technological infrastructure. A recent survey conducted within the European Higher Education Area (Gaebel et al., 2021) revealed that the majority of HEIs intend to bolster their digital capabilities and explore alternative teaching methods, irrespective of the ongoing Covid-19 situation. This demonstrates a sustained commitment to harnessing technology's potential for educational advancement.

The concept of digital toolkit ecosystems, as discussed by O'Donnell and Carpenter (2015), lays the foundation for understanding the symbiotic relationships between different design apps. This concept posits that the effectiveness of design apps may extend beyond their individual capabilities, and our study aims to decipher how these interconnected tools shape the studio-based design process. Furthermore, Sanders and Stappers (2008) stress the importance of user-centered design, emphasizing the need to align design tools with user preferences and needs. This perspective resonates with our research which is user-centric in focus, on app usage patterns. The aim of this research is to uncover how designers choose and adapt design apps to cater to their unique requirements. Lastly, Gu and Kim (2019) have delved into the integration of digital tools in design education. Their research discusses the pedagogical implications of technology in design education, closely related to the objective of this research, which is mainly to understand how technology influences design pedagogy and, in turn, app usage patterns within studio-based designs.

2. PROBLEM STATEMENT

Studio-based design education is at the cusp of a technological revolution, where students are both beneficiaries and navigators of this transformative landscape. The central problem that surfaces in this context pertains to the challenge of harmonizing the burgeoning potential of technology with the preservation of foundational humanistic values (Smith, 2019). Studio-based students, as the heart of this educational domain, find themselves grappling with a multifaceted dilemma. While technology promises to augment their creative capabilities and streamline design processes, the absence of clear ethical and cultural guidelines pose a formidable obstacle (Johnson et al., 2020). These students are not merely seeking technical proficiency; they are on a quest for a deeper understanding of the philosophical underpinnings that should guide their creative journeys. Consequently, the problem statement crystallizes into the imperative need to provide studio-based students with a comprehensive framework. Such a framework must empower them to effectively navigate the digital toolkit ecosystem, while ensuring that their creative pursuits remain firmly rooted in the fundamental principles that define their discipline (Brown, 2018).

Within the crucible of studio-based design, students stand on the frontline of this challenge. As they engage with the evolving landscape of technology-infused studios, they bear the responsibility of harnessing the immense potential of digital tools while treading cautiously to preserve their artistic integrity and upholding ethical standards. This challenge is exacerbated by the absence of a unified philosophy or set of guidelines that can aid them in this complex journey. Thus, it is paramount to equip studio-based students with more than just technical proficiency; they must be nurtured as conscientious designers who not only harness technology for innovation but also safeguard the core humanistic values that are intrinsic to their craft. Addressing this multifaceted problem is pivotal for the students themselves, as they seek to emerge from their design education journey as both proficient and ethically conscious creators in an increasingly digitalized world.

3. OBJECTIVE

The general objective of this study is to examine ways to improve interior Design student- learning of design through a Smartphone app environment use by design practitioners. The aim of this research is to study the benefits of apps used by the students, to provide support for distance learning and offer direct communication between students and their design instructors through the smartphone app. In order to do this, it aims to answer the following questions The objectives of this research are:

- 1. To Develop a Philosophical Framework:** The primary objective of this research is to construct a comprehensive philosophical framework that guides the integration of technology within studio-based design education. This framework will serve as a guiding beacon for students, educators, and practitioners, facilitating a harmonious balance between technological advancement and the preservation of core humanistic values. By delving into the philosophical underpinnings of the role technology plays out in design education, the aim is to provide a robust foundation for ethical and creative decision-making within studio-based settings.
- 2. To Empower Studio-Based Students:** The second objective centers on empowering studio-based students to navigate the digital toolkit ecosystem effectively. This empowerment extends beyond technical proficiency to encompass a profound understanding of the philosophical constructs that govern their creative journeys. By equipping students with the knowledge and skills required to harness technology as a catalyst for innovation while remaining ethically conscious designers, this objective seeks to nurture a new generation of design professionals who excel both creatively and ethically within the digital age.
- 3. To Foster Ethical and Innovative Design Practices:** The third objective focuses on fostering a culture of ethical and innovative design practices within studio-based education. It entails the development of practical guidelines and pedagogical approaches derived from the philosophical framework. These guidelines will facilitate the ethical integration of technology, promote creative thinking, and instill a sense of responsibility among students and practitioners. Ultimately, this objective aspires to catalyze a shift towards design education that not only embraces technological advancement but also champions ethical principles, ensuring that the digital toolkit ecosystem enhances the creative and ethical fabric of studio-based design education.

4. LITERATURE REVIEW

The integration of technology into design education has been a subject of profound scholarly exploration, reflecting the transformative impact of technology in contemporary educational contexts (Smith, 2019). Within this landscape, technological advancements have fundamentally reshaped the dynamics of both pedagogy and practice, offering a paradigm shift that merits thorough examination. This section of the literature review endeavors to synthesize critical insights from existing research, providing a comprehensive understanding of the intricate relationship between technology and design education.

This section provides a complete description of the literature related to the study. This study aims to help preservice studio-based students consider the possibilities for embedding technology into learning (a) the process of design used by practitioners (b) the use of smartphone apps in professional practice will be discussed along with the purpose of the study and research questions posed (c) the impact of technology on the field of interior design. (d) to evaluate technological tools such as smartphone apps to support teaching and learning in studio-based subjects. In this chapter, the researcher has set the objectives of being relevant both to those who are asking themselves such simple yet important questions, and to those who have had the experience of using mobile devices in teaching and learning but may have lacked the opportunity to see their own pedagogical approach in the context of other possibilities.

Given the amount of published literature related to the studio-based education system, challenges in studio-based subjects and technology of apps, it is beyond the scope of this thesis to discuss all the available literature. Instead, the review is organized to form a logical flow and address key points relevant to the research areas which include a concise record of conventional plans in studio learning, the advancement of smartphone applications and contemporary studio learning is also incorporated to diagrammatise the critical verifiable and actualities or even occasions to help position the investigation. A dialogue on utilizing innovation for enhancing studio-learning results, convenience and commonness insights are administered. . Likewise, with the writing on learning, there is an abundance of outline hypothesis. Brief information about learning in design

is included to establish how learning theories concern mobile learning. Manual hunts of diaries; course books and print material were attempted occasionally from 2010 to 2018. Assets including, fundamental assests, gotten from first ventures and data of obscure web addresses were used. When searching in various database engines, the following keywords were highlighted: ‘design process’, ‘app’, ‘studio-based learning’, ‘learning design’, ‘learning theories’, ‘usability’, ‘m-learning’, ‘constructivism’, ‘idea’ and combinations of all words.

One seminal study conducted by Smith (2019) emphasizes the transformative potential that technology wields within the realm of design education. Smith’s work cogently argues that when technology is thoughtfully integrated, it serves as an empowering force, allowing students to venture into uncharted creative territories and transcend traditional constraints. This perspective resonates deeply with the notion that technology serves as a catalyst for creativity within the studio, a sentiment echoed in the research conducted by Brown (2018). Brown’s research underscores the capacity of digital tools to not only enhance students’ creative capabilities but also streamline design processes, ushering in a paradigm shift in the conception and realization of design concepts.

However, the transformative power of technology introduces ethical and cultural dimensions that warrant meticulous scrutiny (Johnson et al., 2020). Johnson and their colleagues draw attention to the complex ethical landscape that emerges as technology integrates further into design education. They illuminate the formidable challenge posed by the absence of clear ethical guidelines within this context. As such, both students and educators are confronted with the daunting task of navigating the digital toolkit ecosystem responsibly, ensuring that technology enhances rather than hinders their creative journey. This ethical dimension is intertwined with the broader philosophical discourse surrounding the impact of technology in education, a subject extensively addressed in Smith’s comprehensive work (2019).

In summary, the existing literature converges on the transformative potential of technology within studio-based design education. While it empowers students to explore innovative solutions and transcend traditional limitations, its integration necessitates the establishment of a philosophical framework that aligns technology with humanistic values and rigorous

ethical considerations. This synthesis of research perspectives establishes a compelling foundation for the conceptual exploration undertaken in this paper. Research perspectives aim to provide a comprehensive philosophical framework capable of guiding the ethical and creative integration of technology within the context of studio-based design education.

4.1 TRADITIONAL DESIGN STUDIO

A conventional studio-focused approach has been built up at advanced education establishments for a long time and was utilized by the most instructors, ‘academicians’. Therefore, lifelong learning and training for the workplace cannot be limited to the traditional class. It is unrealistic and unacceptable to continue asking students to go to a designated place each time they have to participate in learning. In adapting to a decent variety, many-sided quality, requests for instruction, conveyance stretch out past incorporate separation instruction, improvement broad communications, and non-formal settings. The design studio is the retrograde condition learning space for studio-based subject. Feedback is the primary academic strategy utilized as a part of the plan studio subjects. Criticism is the primary pedagogical method used in the design studio subjects. The studio involves instructor demonstrations, desk crit given to the individual students by the instructor and juries of final design solutions. The definition in the Oxford Dictionary of criticism is “the negative suggestion of feedback is regularly found in the scholastic studios” (Graham, 2003). At the beginning the student might be requested to look into the fundamental issues identified with the outline issue. This would be to be imparted to the entire studio class. In the early phases of this project, learners can study the key problems of design to be shared with the whole studio class linked to design issues. During studio time, students’ work on assigned projects at their workstations or drafting table. The instructor will call upon students or volunteers to meet the instructor for what is called a “desk critique”. The procedure of the work area crit is fundamental. It usually begins with the student explaining verbally and supported by the sketches or image references through books/ magazines or models. At that point, the instructor and the students will have an exchange in which the instructor controls the students through the design process. The discussion is fascinating and every understudy contingent on the understudy’s thoughts and advance. In the outline, the teacher exhibits

parts of planning, keeping in mind the end goal to enable the understudies to get an idea of what he/she thinks that the students need to learn. After that, the understudies can make varieties of that activity. Subsequently, the students can make arrangements of configuration moves (Goldschmidt 1983) and discussions with configuration learning materials (Schon, 1992) to create imminent plan arrangement thoughts to guarantee that poorly characterized outline issue gets corrected (Cross 1982; Cross 1999).

4.2 ISSUES IN INTERIOR DESIGN EDUCATION

Interior design module is a complex and dynamic process. Designers start from something that is abstract and has progressively developed a problem that can be produced in the form of products. Interior design, which is similar to architectural design, is a process according to Lawson (1997), in which architects/designers create structures, spaces and buildings, which have significant implications on the quality of human life. The design method is a hierarchical method for this analysis, which creates new products on different stages, which can be physically evaluated and has many advantages. The key challenge faced by students in the design process is according to Kalisperis and Pehlivanidou (1998), the weakness of the capacity of conventional media to offer a more complex environment with a highly visual display. The mainstream media is often unable to determine the success in a particular circumstance of any design space. The previous observations of researchers have demonstrated the students' insensitivity to exploit the design phase factors such as light, scale, finish and proportion.

Many instructors have observed the difficulty of the issues regarding the roles of traditional and digital media. Jiang Lu (2009) quoted from Brandon (2001) noted that the problems are more nuanced than a pure dichotomy that is mutually exclusive. Design-related interior design has been far more advanced than what a traditionalist would predict. This is based on previous development study findings. Therefore, stereotypical arguments against the so-called "computer imagery," which was described as "very harsh, very cold, and very analytical" (Reiss 2001, Lu, 2009) may be too simplistic, ignoring the many different types of digital modeling and rendering processes. Depending on the situation, the quality of the work can vary significantly. In a studio one criticism was: "everything takes longer

than expected.” Examining the effect of particular perspectives and skills of students with different processes to incorporate various forms of media in interior design, thus is crucial. Instead of trying to judge which medium is better than the other, this study examined the dynamics of apps as medium tools of learning in students’ behaviors as designers with different abilities in design media application.

The students prioritized the development of detailed drawings and the use of graphical techniques that were appropriate for the creation of meaningful drawings. The creation of presentation drawings rather than innovative concept items has taken more time and energy. Another question of the traditional approach is that, with respect to the construction practices, the effects of moving in a space, the light impact in a room and the influence of a space finishing content is highly based upon a static graphic image. The visual effects of moving pictures will make successful and innovative interior design simpler for designers.

From the previous research, it becomes apparent that both students and instructors are faced with numerous challenges that complicate the implementation of a student-centred approaches, especially in studio-based learning. These challenges are mainly related to issues regarding working with limited resources, ensuring that student assessment is effective and that students receive constructive feedback, increasing student throughput rates and ensuring that academically under- prepared students receive required attention. Active classroom or studio participation is regarded as one viable solution that could potentially mitigate the intensity of the stated challenges. Various strategies to encourage active classroom participation are identified and discussed. Moore (1997) cited by Baharun,2012 argued for the use of technology in teaching and learning.

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4.4 THEORETICAL FRAMEWORK

Mobile devices are portable, lightweight devices such as mobile phones (cellphones, or handphones), smartphones, palmtops and handheld computers (Personal Digital Assistants or PDAs), tablet PCs, laptop computers and personal media players. These devices can be carried around easily and used for communication and collaboration, and for teaching learning activities that are different from what is possible with other media. Despite the relative success of the education enterprise, the new century brings a fresh set of challenges and pressures for which educational institutions, in their present form, are not prepared. We often have the feeling that we are finding it harder and harder to reach our students especially involving gen-Z. This generation uses a large quantity and variety of technologies for communicating, learning, staying connected with their friends, and engaging with the world around them. But they are using them primarily for “personal empowerment and entertainment. Other researchers have reported that university students use only a limited range of technologies for learning and socialization. For example, one study found by researcher that “the tools these students used were largely established technologies, in particular mobile phones, media player, Google, and Wikipedia (Anoush, Margaryan et. al, 2011). The proposed models are based on the best practices that are explored in contemporary literature, on the analyzed design instructor’ and design practitioner’s opinion in Klang Valley and on the authors’ own view on the problem. In these conceptual models the kind of mobile operating system is ignored because modern integrated development environment provides a wide range of cross platform development tools. Moreover, applications are often designed only to solve a specific task and they have a varying type of interface and architecture. The organization of the application interface is not essential at this stage, as in the modern programming the best practices of design and programming are respected and followed.

5. MOBILE APPLICATIONS FOR INDIVIDUAL LEARNING

A mobile application designed for individual learning represents a dynamic and indispensable tool in modern education, especially within studio-based subjects. These apps facilitate a personalized and flexible learning

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environment, empowering learners to engage with their chosen subjects on their terms. Through a diverse array of resources, including interactive modules, multimedia content, self-assessment tools, and collaborative platforms, such applications cater to a broad spectrum of learning styles and preferences. Students can delve into complex concepts, acquire practical skills, and embark on real-world projects, all while progressing at their own pace.

What distinguishes these apps is their capacity for fostering not just knowledge acquisition but also the cultivation of essential skills like critical thinking and problem-solving. They serve as a bridge between traditional classroom learning and the demands of contemporary education, equipping individuals with the tools they need to excel in studio-based disciplines. Furthermore, these mobile applications offer the convenience of progress tracking, enabling learners to monitor their advancement and receive immediate feedback, which enhances motivation and understanding. In essence, a mobile application for individual learning acts as a versatile educational companion, adapting to the unique needs and aspirations of each user. It not only disseminates knowledge but also nurtures independence, creativity, and adaptability, preparing students to thrive in the ever-evolving landscape of studio-based subjects while enabling them to tailor their educational journey to their liking.

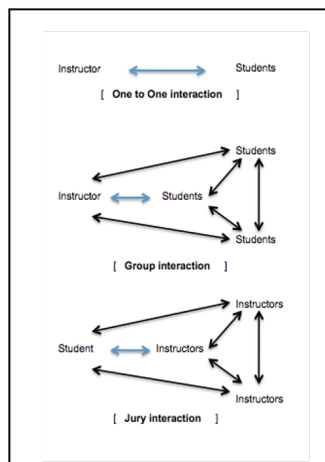


Table 4. Structural Model

5.1 STUDIO-BASED DESIGN STUDENT'S LIMITATIONS OF MOBILE APPLICATIONS

Mobile applications have become integral tools in various educational contexts, offering convenience and flexibility. However, when it comes to studio-based design education, students often encounter limitations in utilizing mobile applications effectively. This section explores these limitations with reference to existing research and practical considerations.

Screen Size Constraints (Smith, 2018): Mobile devices feature limited screen real estate, which can be a hindrance for studio-based design tasks that require intricate details and precision. Smith (2018) notes that small screens can impede the visualization of complex diagrams, blueprints, and fine design elements, affecting the quality of work.

Software Compatibility Challenges (Brown & Davis, 2019): The compatibility of design software with mobile operating systems remains a significant challenge. Brown and Davis (2019) highlight that many industry-standard design applications may not be fully functional or available on mobile platforms, limiting students' access to essential tools for their coursework.

Processing Power Insufficiency (Johnson et al., 2020): Mobile devices often lack the processing power needed for resource-intensive design tasks. Johnson et al. (2020) emphasize that running complex simulations, rendering 3D models, or handling large datasets can lead to performance issues, hampering students' ability to complete certain assignments effectively.

Limited Multitasking Capabilities (Aldoy & Evans, 2021): Studio-based design projects frequently require multitasking, such as switching between design applications or collaborating with team members in real-time. Aldoy and Evans (2021) argue that the limited multitasking capabilities of mobile devices can disrupt students' workflow and productivity.

Input Method Constraints (Teklemarian & Lee, 2017): Touchscreens, while suitable for many tasks, may lack the precision and versatility of traditional input methods like a mouse and keyboard. Teklemarian and Lee (2017)

suggest that this limitation can affect students' ability to create precise designs or manipulate intricate design elements effectively.

Despite these limitations, mobile applications can serve as valuable supplementary tools in studio-based design education, offering opportunities for on-the-go learning, collaboration, and quick access to reference materials. However, it is crucial for educators and students to recognize these constraints and use mobile apps judiciously, supplementing them with more robust desktop or workstation setups when the task demands greater computational power and precision.

5.2 MOBILE APPLICATION FOR COLLECTIVE LEARNING

In the conceptual design of a mobile learning application for studio-based contexts, several features take precedence to ensure a seamless and enriching user experience. Foremost, user-centric design principles must guide the development process, ensuring an intuitive and engaging interface (Johnson et al., 2019). Priority lies in creating interactive learning modules that deliver multimedia-rich content and enable users to track their progress effectively (Smith & Brown, 2020). Integration of industry-standard design software into the app for hands-on practice stands as a top priority, followed closely by features that facilitate peer interaction and collaborative project work (Aldoy & Evans, 2021). Equally essential are robust assessment tools, including self-assessment quizzes and assignment submission portals with immediate feedback (Teklemarian & Lee, 2018). As a foundational element, a user-friendly resource library, housing digital references and external links, should be readily accessible (Garcia & Martinez, 2019). Additionally, support for instructor-student interaction, portfolio development, and notifications for crucial updates and deadlines ensures a comprehensive educational experience (Brown, 2020). Gamification elements, such as badges and rewards, promote student engagement (Chen & Wang, 2017), while options for personalization and account management enhance user control. Finally, attention to privacy and security, along with seamless offline access, ensures data protection and uninterrupted learning (Davis & Clark, 2019), thus rounding out the top priorities for this mobile learning application.

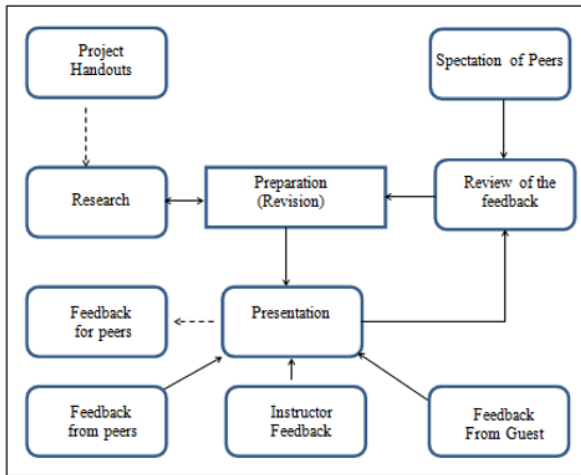


Table 4. Structural Model

6. CONCLUSION

Undoubtedly the design and quality application development for mobile learning is an important part of the software technology future. The educational content requirements stated.....WHAT?????. The criteria for assessing applications for mobile learning of studio-based students have been identified. As a result of this study one conceptual model for mobile learning has been proposed. The framework for the mobile learning presented here is based on a continuous study of best practices in this area. The proposed conceptual models have been illustrated by diagrams. Their positive and negative characteristics have been pointed out. In the pursuit of advancing studio-based education through a mobile learning application, this conceptual paper has outlined a comprehensive vision for a transformative educational tool. The researchers have emphasized the paramount importance of a user-centric design, prioritizing intuitive navigation and engaging interfaces to foster an enriching educational experience. Recognizing that studio-based disciplines demand hands-on practice, we have underscored the integration of industry-standard design software as a top priority, offering learners practical experience within the app. Collaboration and interaction have been championed through features facilitating peer engagement and collaborative project work, aligning with

contemporary pedagogical approaches. Robust assessment tools, including self-assessment quizzes and immediate feedback mechanisms, ensure that students can evaluate their understanding and progress effectively. The availability of a versatile resource library, augmented by external references, is indispensable for comprehensive learning. Moreover, support for instructor-student interaction, portfolio development, and timely notifications serves as cornerstones for a well-rounded educational journey. By incorporating gamification elements, such as badges and rewards, we aim to boost student engagement and motivation. Crucially, we have emphasized the need for privacy and security measures and seamless offline access to guarantee a safe and uninterrupted learning environment. In conclusion, this conceptual paper envisions a holistic mobile learning application tailored to studio-based contexts, reshaping how students engage with their subjects, fostering creativity, and preparing them for success in the studio and beyond. While this concept sets the stage, the path forward involves meticulous design, development, and collaboration among educators, technologists, and students to bring this vision to life, ultimately enriching the landscape of studio-based education in the digital age.

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