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A Platform for Model-based Learning and Gamification in Design Education

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Abstract

This study proposes a design learning platform that combines concepts from gamification, model-based learning, and educational psychology to produce a dynamic learning environment created for design students. The platform's main feature is a gamified approach to design education. It presents students with design quests and challenges that cross a variety of design disciplines. By using a subjective and open-ended approach, this platform encourages problem-solving, and critical thinking. To improve the learning experience, the platform incorporates educational psychology. Real-time feedback mechanisms are integrated with formative assessment methodologies to give students feedback on their progress. Model-based learning tools, such as concept models, 3D design, and flowcharts are incorporated. This helps students in understanding the connections between ideas, visualising complicated design concepts, and applying their learning to real-world situations. Gamification components such as point systems and prizes help to increase motivation and engagement. The platform aims to combine Augmented reality (AR) and Virtual reality (VR) technology into the concept. Students will be able to explore design environments and develop interesting concepts. This advancement will increase the depth and interaction of the learning experience. Primary research was conducted with preliminary prototypes of the platform with students of design to recognise the initial impact of the features of the platform. This showed to improve design thinking and problem-solving abilities. Prototype concepts have been discussed to further develop the platform's capabilities. These concepts include the development of a mobile application to facilitate skill tracking and daily design challenges to encourage innovation. In essence, this design learning platform provides a systemic approach to design education, combining various design methods and principles, educational psychology techniques, and AR and VR technology. It hopes to empower design students by providing them with the skills, information, and drive they need to flourish in the dynamic and ever-changing world of design.

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1. Introduction

Design education is the cornerstone of creativity and innovation, and equips individuals with the skills and mindset to navigate the complex challenges of the ever-evolving world. It is a major factor in the advancement of numerous industries since it enables students to translate abstract ideas into workable solutions and is based on the concepts of critical thinking, problem-solving, and artistic expression. As the contemporary world experiences significant changes, design education finds

itself at a pivotal point. This clarifies the current situation of design education and the urgent problems it faces, laying the groundwork for an examination of a novel idea that has the potential to completely transform the field of design education in the future. A wide range of fields are covered in design education, including user experience (UX) design, industrial design, graphic design, and architecture. It has long been praised for preparing students for careers in the creative industries. However, design education faces several difficulties due to the rapid advancement of technology, changing social

norms, and the pervasive influence of a globally interconnected society. Design education should address environmental challenges as a crucial part of the product development process [1].

Design education has been significantly impacted by the digital revolution. Students studying design must learn to navigate an ever-growing range of digital tools, software, and platforms in an era characterised by pervasive technology. The urgent need for digital literacy, interactive design, and a grasp of user experience in the virtual world contrasts with the conventional, analog methods of teaching and learning. Today's design issues cut across traditional disciplinary lines. Working with specialists from a variety of disciplines, such as psychology, engineering, and environmental science, is frequently necessary for collaborative projects. It is essential to move from discrete disciplines to an integrated approach to prepare students for such challenges. In the current environment, ethical issues in design must be taken into account. Design now encompasses inclusivity, sustainability, and ethical responsibility in addition to aesthetics and functionality. Teachers need to mentor students in ways that support inclusivity, diversity, and environmental awareness in design processes. It is imperative that design education change in this quickly changing environment. It needs to adapt to the needs of a technologically advanced, multidisciplinary, inclusive, sustainable, and globalised world. To tackle these issues head-on, this paper proposes a novel idea that combines gamification, model-based learning, and educational psychology to offer a forward-thinking approach to designing education. This idea reimagines how we train future designers, making sure they are motivated and passionate about solving creative problems in addition to having the knowledge and abilities necessary to succeed in the fast-paced field of design.

2. Related works

2.1. Literature Review

Based on academic investigations, the conversation around design education is dynamic and changing. The recognition and assessment of challenges associated with conventional design education is a recurring pattern. Studies highlight problems like disciplinary silos and argue that inflexible frameworks can impede the acquisition of a broad range of competencies [2][3]. Many papers present conclusions from a cognitive game designed to assess engineering professors' design thinking. The findings demonstrate the differences between Bloom's Taxonomy Cognitive Domain levels, as well as their distribution and application at various design stages [3]. Some papers revealed how students currently seek and receive support for design projects. It is discovered how learners adhere to deadlines and approach social learning. Certain studies additionally revealed how to enable study rhythms that encourage creative flow, as well as how to create creative environments in learners' homes. [4]. Technology integration in design education is another important area that is being examined [5]. The body of research examines how digital design tools affect curriculum and how developments in

technology impact the capacity of learners to acquire technical skills and change the way that education is delivered. Another interesting emphasis is the integration of interdisciplinary approaches, which emphasises the need to dismantle conventional boundaries between design disciplines [5]. Certain researchers investigated the benefits and applications of virtual reality (VR) in various scenarios. VR has a lot of potential, and its use in education has recently caught researchers' interest [6].

Global events have accelerated the recent shift towards online or remote learning, which has sparked debates about how well virtual platforms can impart design education [7]. Academics conduct critical analyses of the difficulties in preserving practical experiences and approaches to guarantee fair access to high-quality education in a digital setting [8]. Design thinking is an essential part of complex problem-solving, including the processes of problem identification, brainstorming solution ideas, developing prototypes, and testing and refining outcomes [9]. The assessment practices used in design education are also being examined, with an emphasis on creating efficient methods that cover both technical proficiency and the use of design thinking [10]. A key theme in the conversation about design education is the need for continuous improvement techniques and continuing professional development for teachers [11]. During the COVID-19 pandemic, using technology in the classroom became mandatory. Educators were forced to adapt to complete the academic year [12]. As a result, the landscape of design education needs to be continuously improved. This change recognises the collaborative setting of the modern design industry and calls on educational institutions to help students develop a more all-encompassing skill set [13].

2.2. Market Research

A market analysis of comparable products in the industry shows that several platforms are attempting to revolutionise design education by fusing gamification, technology, and model-based learning. Canva for Education, Autodesk Education, and Adobe Creative Cloud for Education are a few of the notable rivals. With its array of tools for graphic design, video editing, and other areas, Adobe Creative Cloud for Education offers a complete solution for the development of creative skills. With a focus on 3D design and engineering, Autodesk Education serves students studying architecture, engineering, and manufacturing. Conversely, Canva for Education places a strong emphasis on easily navigable graphic design resources for a range of educational uses. While these platforms emphasise different aspects of design education, they are similar to the proposed concept in that they provide tools for the development of creative skills. Especially in professional design fields, Adobe Creative Cloud and Autodesk Education have become industry standards, bridging the gap between academic and professional settings. With its intuitive interface, Canva for Education serves a wider range of users, including instructors and students from a variety of academic fields. These tools are aimed at those pursuing design education autonomously and not for students in a group setting

such as a university. Neither does it provide any gamified learning systems as opposed to the proposed concept.

3. Methodology

This process includes testing, platform development, and constant improvement in a systematic approach. It creates a dynamic and productive learning environment by combining user-centered design principles, technology, and educational philosophy. The methodology's major features vary from the original design and development phases to user testing and iterative revisions. There is also an emphasis on the significance of real-time evaluation, feedback loops, and a dedication to meeting the ever-evolving needs of educators and students pursuing design. This technique acts as a guide for a transformational learning process that connects conventional design education with the requirements of the modern design environment.

3.1. Interviews and surveys

A selective sampling approach was adopted for primary research. A total of 95 design students aged between 18 to 22, an undergraduate program in design education were interviewed. A series of questions were asked, regarding their experience with educational material in a design context. The questions include, the current state of design education, considering recent changes and developments in the field, the primary challenges that design education is currently facing, technological advancements, such as AR, VR, and AI, impacted the landscape of design education, the role do interdisciplinary approaches play in design education today, and how has this evolved, If does traditional design education align with the demands and expectations of the design industry, The shift towards remote or online learning affected design education, and what are the advantages or disadvantages associated with this transition, specific gaps or areas of improvement that you've identified within current design education methodologies, their perspective on the integration of industry insights and real-world projects into design education curriculum the importance of soft skills, such as creativity, critical thinking, and collaboration, in the current design education landscape, the key factors that contribute to the successful design education programs, and how do design education institutions measure the success and effectiveness of their programs in preparing students for professional success in the field. Each of the answers was later analysed to find similarities and differences to gain useful insights for the ideation process, as well as, concept generation. A list of design goals is formulated and shown. All further analysed data is mentioned and elaborated in the results.

3.2. Framework

The focus on particular disciplines in traditional design education frequently leaves gaps in the development of comprehensive skills. There is a disconnect between traditional education and industry requirements as a result of the design industry's adoption of new technologies like AR, VR, and AI.

In traditional design education, student engagement can present difficulties. Academic knowledge and industry expectations are not aligned. It's not always possible to accommodate the diverse learning styles and preferences of design students. Inadequate systems for continuous evaluation and enhancement of design education approaches. The platform fosters well-rounded skill sets that are essential for modern design professionals by providing interdisciplinary design quests and challenges. With the help of the platform's model-based learning integration, students can apply and visualise their design concepts to real-world, industry-relevant problems. An example case study takes place within a university design program, where a first-year design studio course focuses on basic design concepts. The course aims to cultivate students' abilities to integrate environmental considerations into architectural projects while promoting innovative design solutions. Further details of the case study and its implementation are mentioned in the results.

The proposed mobile application makes it easier to track ongoing skill development and daily design challenges, which encourages lifelong learning. Collaborations with the industry, professional insights, and adherence to industry standards guarantee that the platform offers skills that are immediately useful in the workplace. The analytics and reporting layer of the platform facilitates evidence-based decision-making, which enables administrators and educators to continuously improve and modify the learning process.

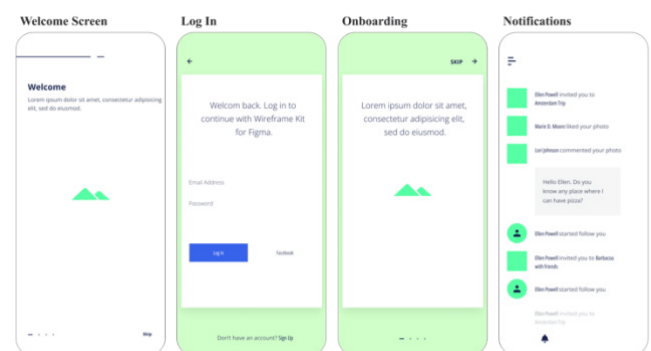


Fig.1 Preliminary wireframes

3.3. System Architecture

a) User Interface (UI): The web application and mobile interface are both included in the Platform. The dashboard has been meticulously designed to provide an easy-to-use interface that ensures seamless navigation and easy access to design challenges, quests, and instructional materials. The user interface (UI) includes gamification components to increase user engagement. A user-friendly interface of the integrated Skill Tracking component helps users keep track of their learning progress and skill improvement. The interface encourages a visually appealing and functionally efficient platform for design education by prioritising aesthetic appeal while also adhering to industry standards. An example website screen was created to show the interface and aesthetic of the platform. The screen is presented in Fig. 2

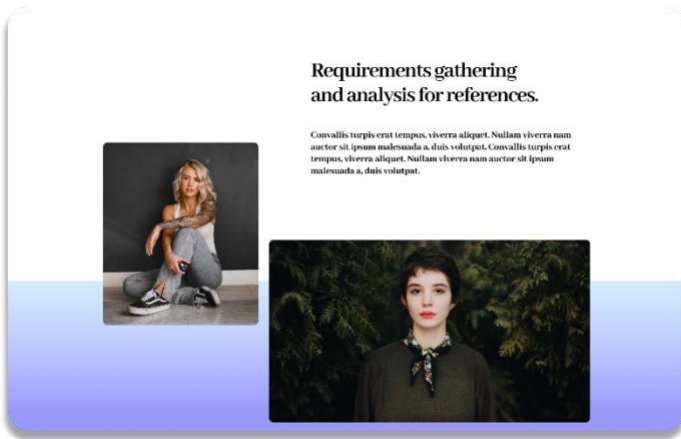


Fig. 2 Website Screen

b) The application: This includes the primary logic and necessary features, and is the foundation of the Platform. Essentially the Design Challenges Engine manages the creation and provision of multidisciplinary design challenges, providing

with ease and still have a consistent and cohesive learning experience.

d) Data analysis and reporting: The Platform's Data Analysis and Reporting features are essential as they provide extensive tools for examining user data, monitoring progress, and producing informative reports. A vital component is Learning Analytics, which closely monitors user participation, development, and performance on design challenges. This gives educators and learners insightful information about both individual and group accomplishments. This layer's reporting tools provide thorough reports that enable administrators and educators to evaluate the platform's overall effectiveness and make well-informed decisions for ongoing development. Personalised learning paths are actively suggested by predictive analysis, which uses collected information to predict user preferences and promotes a customised and adaptable educational experience.

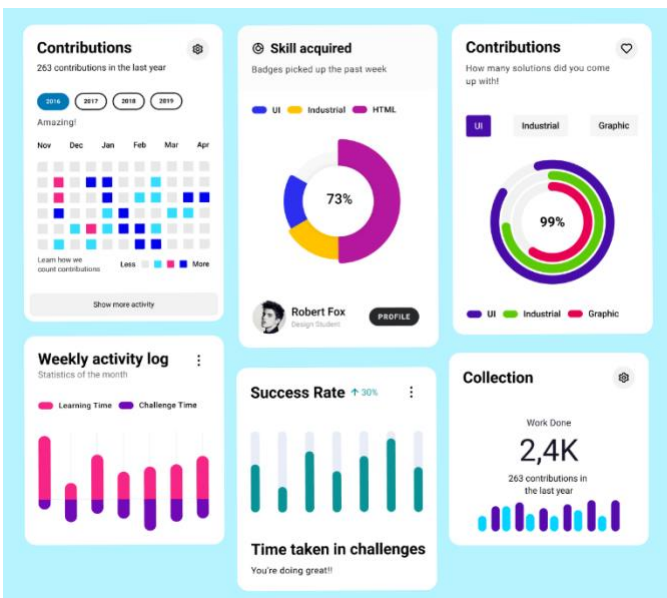


Fig. 3 Graphical Reports

students with engaging and practical scenarios for problem-solving. Through the smooth integration of concept models, visualisation tools, and flowcharts, the challenges enhance the learning process and promote a deeper comprehension of design concepts. Additionally, the Feedback and Assessment Module is essential because it offers real-time insights into design submissions, which facilitates tailored learning and ongoing improvement. UI screens for the application are shown in Fig.4.

c) The integration: The integration facilitates seamless interaction between internal and external services by acting as the platform's communication backbone. The Mobile Application Integration component makes sure that the web application and the mobile application are in sync and work together in harmony, allowing users to switch between devices

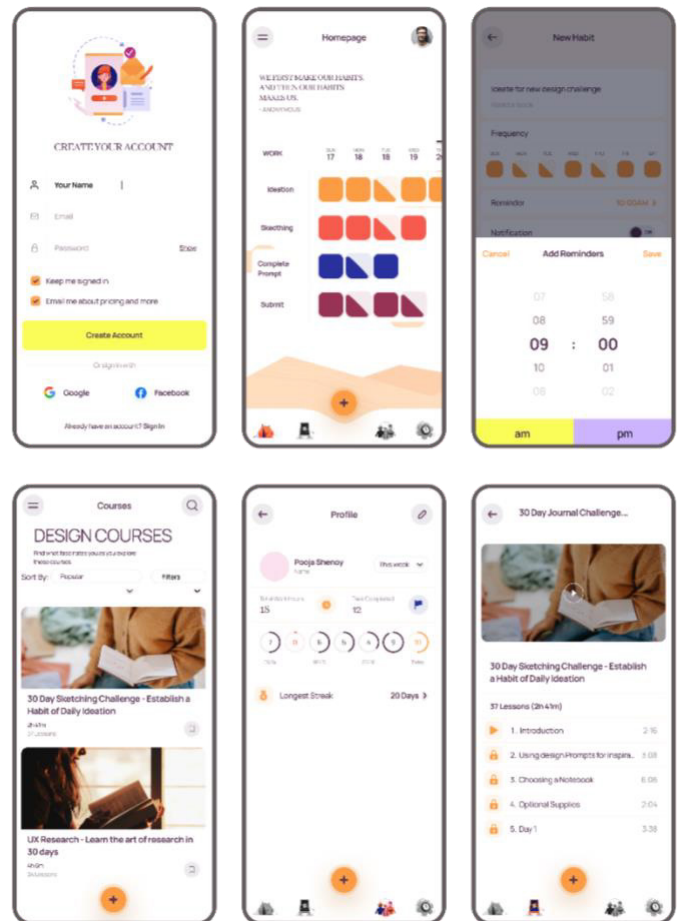


Fig. 4 UI Screens

e) Security and compliance: The Platform is committed to protecting user data integrity and making sure that platform operations follow strict security guidelines. The use of encryption and secure protocols, which are essential for protecting sensitive data from potential threats and ensuring the security of data transmission and storage, is a cornerstone in this. Acting as a gatekeeper, the Access Control component carefully monitors user permissions and access levels to ensure

that users are only granted access to the resources and functionalities that are relevant to their roles. In addition, the layer incorporates Compliance Checks, which deliberately verify that the platform conforms to data protection laws and educational standards. The platform's robust security measures not only promote user trust but also ensure that operations are conducted securely, ethically, and in alignment with industry and legal standards.

4. Integrated framework for gamified design education

In the framework of conventional design education, a recurring pattern occurs. There is an over-emphasis on particular disciplines that unintentionally leaves gaps in the development of a comprehensive skill set. This focus on specialised areas may unintentionally prevent students from developing a comprehensive skill set which might limit their capacity to adapt to the constantly changing demands of the design business.

4.1. Bridging the gap between academic and industry design:

There is an obvious gap between the real-world demands of the design industry and the academic areas of design education as mentioned in the market study. Although it imparts academic information, the traditional educational approach might not be able to provide students with the insights and practical abilities that companies are looking for. The relevance and application of academic learning in professional contexts are called into doubt by this duality.

4.2. Diversity in learning styles and assessment:

Students studying design, naturally have varied learning styles and frequently find themselves in classroom settings that do not adequately accommodate such diversity. Creating a truly inclusive and productive learning environment requires acknowledging and addressing the diverse ways in which students absorb and process knowledge. The conventional methods for evaluating and refining design education approaches are frequently insufficient. It may be more difficult to identify areas that need improvement or refinement promptly if there are no methods for continuous evaluation. The dynamic and responsive nature of education demands ongoing assessment and modification to satisfy the changing demands of the design industry and students alike. This framework fulfills these needs.

5. Results

5.1. Interviews and surveys:

The interviews relating to design education produced an in-depth understanding of the various factors affecting this constantly developing domain. Participants emphasized the importance of a comprehensive educational strategy that goes beyond the development of technical skills. Throughout the discussions, there was an ongoing topic that highlighted how important it is for design education to foster not only technical proficiency but also the development of creativity, critical thinking, and a deep understanding of user needs. Interviewees

all agreed that project-based learning is essential. This method was thought to have played an important part in bridging the gap between theoretical understanding and practical application, developing a skill set that is essential for success in the design sector. Participants also stressed how important it is for design education programs to be flexible to keep up with the ever-evolving technological landscape and changing trends in the industry. Graduates need to be well-prepared for the opportunities and challenges in the design field, and this requires them to be able to integrate emerging technologies and stay ahead of industry shifts. Another recurring theme among the interviewees was the significance of encouraging interdisciplinary collaboration and the importance of students interacting with a variety of fields outside of design. The adoption of an interdisciplinary approach was perceived as a crucial factor in expanding students' horizons, stimulating inventive thought processes, and equipping them for the cooperative environment of the modern design sector. The knowledge gathered from a sample size of 95 design students offers an extensive and nuanced picture of the present situation and future possibilities for design.

5.2. Gamified features:

The platform incorporates gamification elements, interactive challenges, and real-time feedback mechanisms in recognition of the significance of student engagement. This increases student motivation and promotes involvement in the learning process, turning the educational process into an interesting and fulfilling endeavour. The platform incorporates gamified learning, which goes beyond theoretical instruction. It is made easy for students to move from conceptual knowledge to practical application, equipping them for the obstacles they will face in the workplace.

Some examples of the features proposed are point systems, badges based on achievements, and leaderboards. Students earn points for meeting design criteria, demonstrating creativity, and working towards sustainability goals. Points are awarded based on the quality of design solutions, adherence to project specifications, and effectiveness in responding to feedback. A leaderboard system monitors students' progress and achievements throughout the design challenge, instilling a sense of competition and encouraging participation. Students may have access to leaderboards, which allow them to compare their performance to that of their peers and strive for improvement. Students earn badges for completing milestones and demonstrating mastery of specific design skills or concepts. Badges serve as tangible markers of achievement, encouraging students to strive for excellence and acknowledging their progress over time. By incorporating these gamified elements, the design challenge transforms into not only a learning experience but also a dynamic and engaging game-like environment in which students are encouraged to excel and push the limits of their creativity.

5.3. Mobile Application and website prototyping:

Acknowledging the importance of ongoing education and skill enhancement, the platform also offers a mobile application. With the help of this adaptable tool, students can monitor their development, participate in daily design challenges, and promote a culture of creativity that goes beyond the walls of the classroom. The platform actively collaborates with industry professionals, seeks professional insights, and aligns its offerings with industry standards to guarantee direct relevance to the workforce. Doing this ensures that the knowledge and abilities transferred are not only sound academically but also immediately applicable and in high demand in the workplace.

5.4. Analysis and reporting:

Analytics and reporting layers are incorporated into the platform as part of its commitment to evidence-based decision-making. With the help of this layer, educators and administrators can improve the learning process by refining it in light of real-time data. The feedback loop is dynamic and guarantees that the platform stays at the forefront of successful design education. This Platform shows up as a complete answer, tackling the intricate problems of conventional design education in a forward-thinking, flexible, and inclusive manner. It does more than just cover gaps; it changes the face of education, equipping students in design with the skills necessary not only for the demands of the industry today but also for potential future opportunities and challenges. Graphical representations of the collected reports are presented in Fig. 3.

6. Discussion

At the beginning of each design challenge within a course, students are presented with a comprehensive design brief. This brief outlines all the requirements of the project, covering aspects like functional specifications, aesthetics, and sustainability goals. By clearly defining the project parameters, students are better equipped to approach the design challenge with a solid understanding of the problem that they need to solve. After going through the briefing, students can conduct a brainstorming session to generate design ideas. This phase encourages both individual exploration and collaborative teamwork, enabling students to find inspiration from different perspectives. Students explore different design concepts and approaches using techniques such as sketching, mind mapping, and group discussions while taking into account factors like spatial organization, aesthetics, user experience, and environmental impact. Once the initial ideas have been generated, students move on to the concept development stage. Using VR headsets and AR-enabled devices, students can engage in interactive simulations and manipulate 3D models with novel realism, which improves their understanding of design principles and encourages creativity and innovation.

Faculty feedback focuses on design unity, sustainability strategies, and user performance, allowing students to refine their ideas and address potential flaws. With feedback from faculty and peers, students engage in iterative design processes to further refine their ideas. Finally, students present their refined design proposals to their classmates and faculty. These presentations allow students a chance to articulate their design logic, communicate their ideas effectively, and defend their design decisions. Presentations can take the form of formal presentations allowing students to showcase what they've created while having a constructive dialogue with their audience.

7. Conclusion

This design learning platform seamlessly integrates gamification, model-based design learning, and educational psychology principles to create a dynamic and adaptable learning environment. It is an important shift in the field of design education. The platform's comprehensive approach fills in the gaps in conventional design education by providing interdisciplinary design challenges and quests that develop the well-rounded skill sets needed by modern design professionals. It also gets students ready for the technological demands of the contemporary design landscape. Ultimately, this design learning platform proves to be an innovative solution, equipping design students with the abilities, information, and drive required to succeed in the fast-paced and competitive field of design.

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