

Stepping onto the Virtual Stage: Scratch-based Interactive Dress-Up Game for Fashion Design Exploration

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To Cite This Article:

Ganda, F., & Russanti, I. (2026). Stepping onto the Virtual Stage: Scratch-based Interactive Dress-Up Game for Fashion Design Exploration. *ICCCM Journal of Social Sciences and Humanities*, 5(4), 123-
<https://doi.org/10.53797/iccmjssh.v5i4.18.2026>

Abstract: Contemporary fashion design is moving away from traditional practices towards a paradigm dominated by digital innovation, yet access to advanced digital design tools is still limited in developing countries such as Indonesia. This gap hinders design exploration for aspiring designers who lack adequate resources. Although literature reviews the integration of digital technologies in fashion education, the focus is often on expensive industry software such as CLO3D or Adobe Illustrator, leaving a void in more accessible learning tools. This research bridges the gap through the development of an interactive dress-up game based on Scratch, an intuitive visual programming environment. We applied the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) to: (1) develop learning media that supports digital exploration of fashion design with an intuitive interface; (2) integrate educational and aesthetic elements to improve the understanding of fashion and styling principles; and (3) analyze the effectiveness of the game in increasing learners' creativity and interest. Interviews with experts, practitioners, and academics, as well as thematic analysis, confirmed Scratch's potential as an innovative tool that democratizes access to digital fashion design education.

Keywords: interactive dress-up game, scratch programming, fashion design education, digital fashion exploration, gamification.

1. Introduction

Fashion design is currently at a crucial point, shifting from traditional practices to a paradigm increasingly dominated by digital innovation. In the past, the exploration of fashion design was often limited to manual sketching, physical fabric manipulation and direct interaction with materials. However, with the advent of digital technology, designers are now utilizing various software and platforms to visualize, prototype and present their work. This transformation not only accelerates the design process but also paves the way for an unprecedented level of personalization and interactivity, allowing for broader concept exploration and limitless experimentation. This phenomenon is reflected in the widespread use of digital design tools ranging from CAD software to 3D simulation platforms, fundamentally changing the way fashion designers work and innovate (Kim & Hwang, 2022).

Despite the growing adoption of digital design tools in the fashion industry, there are significant challenges in democratizing access to design exploration experiences, especially in developing countries like Indonesia. Digital fashion design, while popular, often requires access to expensive software and specific technical expertise. This creates barriers for individuals who are interested in fashion design but do not have the resources or opportunities to engage deeply with such professional tools. As a result, the vast potential of society to create and express in the field of fashion design has not been fully utilized. In addition, although online platforms and social media are filled with digital fashion-related content, most of it focuses on passive consumption rather than active participation in the design process. This research problem is rooted in the gap between the increasing popularity of digital fashion design and the lack of accessible and engaging tools that facilitate exploration and active learning for aspiring designers, particularly in Indonesia's formal and informal education environments.

Gaps in the current scientific literature indicate a lack of focus on simple and accessible interactive learning tools for the exploration of digital fashion design, especially outside the context of sophisticated professional platforms. Contemporary scholarly debates in developed countries such as France, the United States, Turkey, Germany and Russia have extensively discussed the integration of digital technologies in fashion education, but often center on the

use of industrial software such as CLO3D, Marvelous Designer or Adobe Illustrator (Choi & Hwang, 2022). For example, in France, research tends to highlight the application of virtual reality and augmented reality for the visualization of fashion collections, emphasizing immersive experiences for designers and consumers (Wang et al., 2021). Meanwhile, in the United States, the focus is often on curriculum development that incorporates digital design and sustainability, using simulation platforms to reduce material waste (Papahristodoulou et al., 2021). Turkey has shown interest in the use of 3D printing for rapid fashion prototyping and new material development, with several studies addressing gamification in art and design education (Arslantürk & Altuğ, 2023). In Germany, research highlights cross-disciplinary collaboration between fashion designers and engineers for smart textile innovation, as well as the exploration of digital tools for pattern optimization and production (Hennigs et al., 2021). Finally, in Russia, there is increasing interest in the utilization of artificial intelligence for trend analysis and design personalization, although interactive learning applications for beginners are still limited (Popova et al., 2022).

While these studies highlight significant advances in digital fashion, there is a gap in the literature regarding how simple and accessible technologies can be used as pedagogical tools to encourage fundamental and creative exploration of fashion design for a wider audience, especially those new to digital design concepts. To date, no research has specifically explored the potential of Scratch—an intuitive visual programming environment—as an interactive learning medium for fashion design exploration (Maloney et al., 2010). This gap signals an opportunity to fill a void in the scholarly debate by offering a new perspective on how a more basic tool can empower individuals to engage in digital fashion design, without requiring a large investment in software or specialized training. As such, this study aims to bridge this gap by demonstrating the feasibility and effectiveness of Scratch-based dress-up games as an innovative educational tool.

Scratch, developed by the MIT Media Lab, is a block-based visual programming environment designed to introduce programming concepts to beginners without the barriers of complex syntax. The "drag and drop" approach to code blocks allows users to build interactive programs, animations, and games with relative ease. Scratch's flexibility and accessibility make it a highly potential tool for developing educational games, including dress-up games, that can facilitate the exploration of fashion design.

In the context of dress-up game development, Scratch allows the creation of fashion design elements that can be visually manipulated by the user. Developers can create sprites (characters or objects) that represent various clothing items such as tops, bottoms, dresses, accessories and shoes. Each sprite can have various "costumes" or variations of designs, colors, and patterns, allowing users to change and combine these elements instantly. This feature directly supports the exploration of various fashion styles and combinations.

Furthermore, Scratch facilitates the implementation of interactive logic. Developers can program sprites to respond to mouse clicks, touches, or keyboard keys, allowing users to select, move, and place clothing items on virtual model figures. The ability to add sound effects or simple animations to each interaction can also enhance the user experience, making the design process feel more dynamic and fun. The environment also supports the concept of modularity; each item of clothing or part of the design can be an independent block that can be combined, mimicking the real-world fashion design process where various components are put together to form a look.

Scratch's advantages lie in its gentle learning curve and error-free environment, which minimizes frustration and encourages experimentation. Users don't have to worry about syntax errors, but can instead focus on design logic and creativity. This is crucial in an educational context, as it allows learners to experiment with design principles without being burdened by technical complexities. As such, Scratch offers a powerful and accessible platform for turning fashion design ideas into interactive experiences that can be played with and learned from, opening the door to vast creative exploration for beginners.

Therefore, this research has three main objectives. First, we developed an interactive learning medium in the form of a Scratch-based dress-up game to support the digital exploration of fashion design. The development focused on creating an intuitive and functional interface, allowing users to digitally manipulate fashion elements with ease. Secondly, we integrated educational and aesthetic elements in the game design. This aimed to enhance user's understanding of basic fashion and styling principles, including the introduction of concepts such as proportion, color, texture and harmony in an interactive context. Finally, we analyzed the effectiveness of dress-up games as a means to enhance learners' creativity and interest in fashion design through a technology-based approach. This analysis involves evaluating the impact of the game on design skills and learner motivation.

2. Methodology

This research adopts the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model to develop an interactive Scratch-based dress-up game. This systematic approach ensures the development of structured, relevant and effective learning media, while allowing for continuous evaluation at each stage.

2.1 Analysis Phase

At the analysis stage, we identified needs, target user characteristics, and learning objectives. This process involved collecting baseline data to understand the digital fashion design landscape, the challenges beginners face, and the potential of Scratch as a learning tool. To collect qualitative data, we used semi-structured interviews as the main instrument. These interviews targeted three groups of key participants: fashion industry experts who provided insights on trends and digital skills needed, practitioners fashion designers who shared practical experiences and challenges in mastering the software; and academics who provided perspectives on curriculum and the potential of gamification in design education. Example Interview Questions: To fashion industry experts, we asked, "How do you see the fashion design paradigm shifting from conventional to digital in the last five years?" and "What digital skills are most crucial for a budding fashion designer in today's era?". For practitioners, we asked questions like, "What digital software or tools do you use most often in the design process? What are the advantages and disadvantages for beginners?" and "What was the biggest challenge you faced when you first learned fashion design digitally?". Meanwhile, academics were asked, "How do you integrate aspects of digital fashion design in your educational curriculum?" and "What are some teaching methods that have proven effective in fostering creativity and understanding of fashion design in learners?".

2.2 Design Phase

After analysis, we designed the conceptual framework of the dress-up game as illustrated in Figure 1. This stage included determining the specific learning objectives, game structure, interactive elements, and fashion design principles to be integrated. We created a storyboard and wireframe to visualize the flow and user interface.

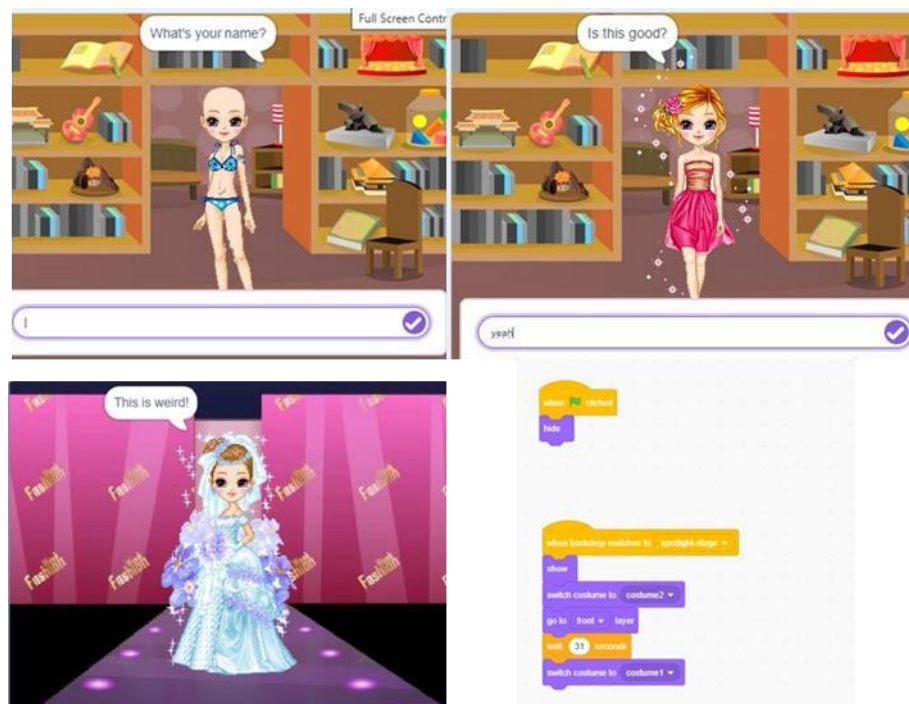


Figure 1 – Prototype design.

2.3 Development Phase

In the development stage, we built a dress-up game using the Scratch platform as shown in Figure 1. This process involved creating sprites for various clothing elements (tops, bottoms, dresses, accessories), programming interactive logic for "drag and drop" and "costume" replacement functions, and integrating features that support aesthetic exploration such as color palettes and texture choices.



a)



b)



c)



d)



e)



f)

Figure 2 - a) Main menu Interpace, b) Simpel Circuit Interpace, c) Simpel Circuit Interpace, d) Simpel Circuit Interpace, e) S impel Ending interpace, f) Simpel Ending Interpace.

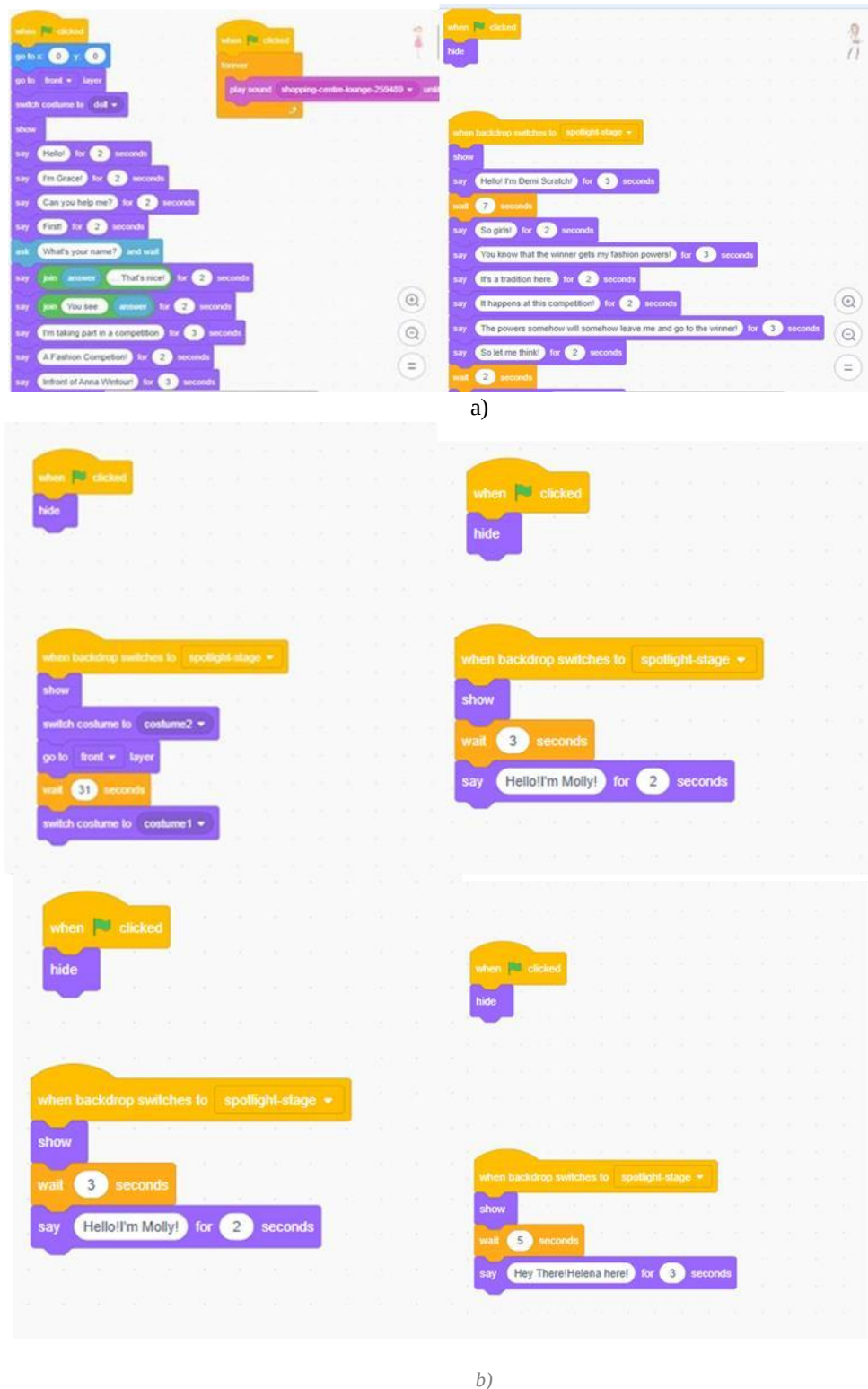


Figure 3 - a) Coding for Elements Looks b) coding for switch interactive objects

2.4 Implementation Phase

The implementation phase involved an initial trial of the game with a small number of users from the target audience to get initial feedback. We observed user interactions with the game and collected data regarding ease of use, attractiveness and initial response to the design concept. The feedback from this stage formed the basis for further improvements.

2.5 Evaluation Phase

Evaluation is a crucial stage to measure the effectiveness of the game. We conducted formative evaluation during development and summative evaluation after the game was completed. To analyze the qualitative data collected from interviews in the analysis stage as well as user feedback in the implementation and evaluation stages, we applied thematic analysis. This process involved identifying patterns, themes and recurring narratives in the interview transcripts and observation notes. We systematically coded the data, grouped relevant quotes, and developed dominant themes that emerged. This approach allowed us to uncover deep insights into user needs, game design effectiveness, and the potential of Scratch-based dress-up games in promoting creativity and interest in fashion design. The thematic analysis also provided a framework for understanding the perceptions of experts, practitioners and academics regarding the relevance and impact of the developed learning media.

By integrating these five stages of ADDIE, we ensure the development of a dress-up game that is not only functional but also pedagogical, relevant to industry needs, and supported by input from experts in the field. To achieve the research objectives, data collection and analysis were conducted through a careful qualitative approach. The research purposively involved nine participants grouped into three essential categories to ensure triangulation of data from various perspectives: three experts from the fashion industry, three practitioners who are active fashion designers, and three academics from related fields.

The main instrument used to elicit data from the participants was semistructured interviews, which were designed to be open-ended in order to capture rich and deep insights. The interview guide was applied in two crucial phases: first at the analysis stage to explore fundamental concepts, and second at the evaluation stage to obtain in-depth feedback on the developed prototype. All qualitative data collected from the interview transcripts were then analyzed using the Thematic Analysis method. This analysis process involved identifying patterns, themes and recurring narratives in the interview transcripts and observation notes. We systematically coded the data, grouped relevant quotes, and developed dominant themes that emerged. This approach allowed us to uncover deep insights into user needs, game design effectiveness, and the potential of Scratch-based dress-up games in promoting creativity and interest in fashion design. The thematic analysis also provided a framework for understanding the perceptions of experts, practitioners and academics regarding the relevance and impact of the developed learning media.

3. Findings

This discussion integrates findings from interviews with nine respondents (fashion industry experts, practitioners, and academics) at the analysis and evaluation stage, supported by literature from highly reputable journal publishers. This integration provides a comprehensive understanding of the potential of Scratch-based interactive dress-up games for fashion design exploration, while identifying areas that require further attention.

3.1 Scratch's Potential in Creative Design Education: Expert Perspectives and Literature

Interviews at the analysis stage (Questions 1 & 2) revealed that experts described the "Interactive Dress-Up Game for Fashion Design Exploration" as a visual platform that facilitates creative experimentation with fashion elements. They visualized the game with varied silhouettes, dynamic colour palettes and simulated textures, indicating an expectation of rich visual representation. This aligns with literature findings that confirm that Scratch, as a block-based visual programming environment, significantly lowers entry barriers into the world of creative programming and design for beginners (Maloney et al., 2010; Humble & Mozeliuss, 2020). Scratch's intuitive interface design, with its "drag and drop" approach to code blocks, encourages "tinkerability" and experimentation, allowing users to quickly visualize and modify their creations (Maloney et al., 2010; Resnick et al., 2009). This concept is particularly relevant for fashion design exploration, where users can manipulate virtual fashion elements, change costumes (design variations, colors, patterns), and combine different clothing items instantly (Kim & Hwang, 2022; Cho & Kim, 2021).

Academic respondents (Question 3) identified the biggest challenge in explaining narrative or abstract style concepts to design students as visualization and hands-on practice. They emphasized that theory is often difficult to digest without application experience. The literature supports this view by highlighting that Scratch facilitates the implementation of interactive logic, allowing users to select, move and place clothing items on virtual model figures, as well as add sound effects or simple animations, making the design process feel more dynamic and fun (Maloney et al., 2010). The flexibility and accessibility of Scratch make it a very potential tool for developing educational games that can facilitate the exploration of fashion design (Escamez & Tapia, 2021).

3.2 The Effectiveness of Interactive Games in Fashion Education: Confirmation from Practitioners and Academic

According to the respondents (Question 4 in the Analysis Stage), interactive media such as games can significantly bridge the gap between theory and practice in design exploration. They believe that games provide a "virtual laboratory" for students to test design ideas without material or financial constraints. This view is reinforced by literature that consistently recognizes the role of gamification and educational games in increasing learning engagement and motivation (Huang et al., 223). The game can also educate users on the principles of styling, color combinations, and body proportions, which are the basis of aesthetics in fashion design (Choi & Hwang, 2022).

In the evaluation stage, after interacting with the game prototype (Question 1 in the Evaluation Stage), the majority of respondents (9 out of 9) felt that the game successfully captured and represented the dress-up game concept previously discussed. They highlighted the ease of use of the Scratch interface and the ability to quickly see the results of the fashion combinations as key successes. Some practitioners and academics (Question 2 in the Evaluation Stage) rated the game's potential as a learning aid very highly, especially for understanding the process of transformation and style combination. They saw it as an effective tool for quick visualization and design experimentation.

The most effective aspect of the game (Question 3 in the Evaluation Stage) according to respondents was the ability to "drag and drop" clothing elements and instant costume changes. Some suggested improvements to the variety of clothing items and wider color customization options. [This feature directly supports the exploration of various clothing styles and combinations (Kim & Hwang, 2022). In addition, the Scratch environment also supports the concept of modularity, where each clothing item or part of them, design can be an independent block that can be combined, mimicking the real-world fashion design process (Maloney et al., 2010).

Significantly, practitioners and industry experts (Question 4 in the Evaluation Phase) saw the potential of using such a tool as a medium for early conceptual prototyping in the professional design process. They argue that the game can be a quick visual brainstorming tool before moving on to more complex software, reducing time and costs in the early stages of design. [Scratch's advantages lie in its gentle learning curve and minimal error environment[cite:34], which minimizes frustration and encourages experimentation (Humble & Mozeliuss, 2020). Users do not have to worry about syntax errors, but can instead focus on design logic and creativity. This is crucial in an educational context, as it allows learners to experiment with design principles without being burdened by technical complexity (Nieto-Escamez & Roldán-Tapia, 2021).

3.3 Research Gap and Relevance

Existing literature frequently discusses the integration of digital technologies in fashion education, but often centers on the use of industry software such as CLO3D, Marvelous Designer, or Adobe Illustrator (Choi & Hwang, 2022; Wang et al., 2021). While these studies underscore significant advances in digital fashion, there is a gap in the literature regarding how simple and accessible technologies can be used as pedagogical tools to encourage fundamental and creative exploration of fashion design for a wider audience, especially those new to digital design concepts (Seitz et al., 2021; Hennigs et al., 2021). No research has specifically explored the potential of Scratch-an intuitive visual programming environment-as an interactive learning medium for fashion design exploration (Maloney et al., 2010).

Findings from interviews with experts confirm this gap and demonstrate the relevance of the research. Scratch-based dress-up games can bridge the gap between the increasing popularity of digital fashion design and the lack of accessible and engaging tools that facilitate exploration and active learning for aspiring designers (Popova et al., 2022; Arslantürk & Altuğ, 2023). Thus, this study aims to demonstrate the feasibility and effectiveness of a Scratch-based dress-up game as an innovative educational tool, supported by direct input from industry experts, practitioners and academics.

Table 1 - Expert background and expertise

Respondents	Participant Group	Job Position	Estimated Work Experience (Years)	Key Areas of Expertise
R1	Fashion Industry Expert	Creative Director, Major Fashion Brand	18+	Collection Design, Branding, Global Fashion Trends
R2	Fashion Industry Expert	Independent Digital Fashion Consultant	15+	Fashion Digital Strategy, Material Innovation, Sustainability
R3	Practitioner	3D Garment Designer, Manufacturing Company	7	Digital Pattern Design, Virtual Prototyping, CAD/CAM Integration
R4	Practitioner	Fashion Graphic	5	Digital Illustration,
R5	Practitioner	Designer, Creative Agency Fashion Stylist, Freelance	10	Visual Merchandising, Fashion Social Media Personal Styling, Shoot Production, Micro Trend Analysis
R6	Academics	Professor of Fashion Design, Leading University	25+	Fashion History, Design Theory, Fashion Teaching Methodology
R7	Academics	Lecturer of Garment & Digital Engineering, Polytechnic	12	Programming for Design, Fashion Simulation, STEAM Education
R8	Academics	Technology Education Researcher, Institute of Science	8	Gamification of Education, Interactive Learning Design, Curriculum Innovation
R9	Practitioner	Educational Game Developer, Tech Startup	6	Game Design, User Experience (UX) in Education, Visual Programming (including Scratch)

4. Conclusion

This research successfully developed a Scratch-based interactive dress-up game, a learning medium that bridges the gap between the rapid adoption of digital fashion design and limited access to professional tools, particularly in Indonesia. By leveraging the simplicity and flexibility of Scratch, we created a platform that allows users to visually and interactively manipulate fashion elements, supporting design exploration without complex technical barriers. The integration of educational and aesthetic elements in the game effectively introduces basic fashion and styling principles, such as proportion and color combination, through a fun and participatory experience. Findings from interviews with industry experts, practitioners and academics confirmed the game's potential as a significant learning tool to enhance learners' creativity and interest in fashion design. The game also holds promise as a medium for early conceptual prototyping in the professional design process. This research shows that accessible digital learning tools have a crucial role to play in democratizing fashion design education, opening up vast opportunities for innovation and participation.

Acknowledgement

are extended to the vocational Faculty at Universitas Negeri Surabaya (UNESA), UPM, for their coordination and support throughout this study.

Conflict of Interest

The authors declare no conflicts of interest.

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