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# Developing an Interactive Digital Fashion Catalog on Scratch with a Skin Tone Mix and Match Game

Laisoka, Natzwa Krasumy<sup>1</sup> & Russanti, Irma<sup>1\*</sup>, Arman Shah Abdullah<sup>2</sup>

<sup>1</sup>Department of Applied Science Fashion Design, Faculty of Vocational, Universitas Negeri Surabaya, Surabaya, 60231, INDONESIA

<sup>2</sup>Faculty of Technical and Vocational, Universiti Pendidikan Sultan Idris, MALAYSIA

\*Corresponding author email: [irmarussanti@unesa.ac.id](mailto:irmarussanti@unesa.ac.id)

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**Abstract:** Digital technology intervention has shifted the fashion consumption paradigm, yet it has created a visual "representational gap" on e-commerce platforms that fail to represent consumer skin tone diversity. This failure negatively impacts consumer confidence and increases the potential for product returns. This study aims to bridge this gap by developing an accessible solution through a prototype of an interactive digital fashion catalog using the Scratch platform. Its main functionality is the simulation of mixing and matching apparel on two skin tone variations. Using the ADDIE methodology with a qualitative approach, this research conducted interviews with three key respondents (an industry expert, a practitioner, and an academic) to evaluate the prototype. Thematic analysis results show a strong consensus regarding the urgency of the representation issue. The developed prototype was positively received for its simplicity, its effective functionality as an initial solution, and its intuitive interaction. The findings also validate the great potential of Scratch as a rapid prototyping tool that democratizes innovation for small-scale designers and as an educational medium in the fashion field, confirming that accessible solutions can be key to a more inclusive fashion ecosystem.

**Keywords:** ADDIE, Digital Catalog, Scratch, Inclusivity, Skin Tone, Fashion Technology

## 1. Introduction

The design paradigm and fashion consumption process in the contemporary era are currently undergoing a significant fundamental transformation, a shift almost entirely driven and shaped by the massive intervention of digital technology (Bertola & Teunissen, 2018). Far beyond the now-established realm of transactional e-commerce, the global fashion sector is actively moving towards the creation of much more immersive, interactive, and deeply personalized user experiences (Lamberton & Stephen, 2016). This evolution is clearly marked by the emergence and popularity of revolutionary concepts such as digital fashion, where garments exist only in virtual form (Baek et al., 2022); virtual try-on technology that allows consumers to "try on" clothes through their device's camera (Kakade et al., 2024); and the use of widely customizable avatars within the metaverse (Lee et al., 2023). In this new landscape, technology no longer merely functions as a passive medium for facilitating transactions but has actively transformed into a dynamic arena for consumers to conduct limitless creative exploration, realistic product visualization, and independent validation of fashion choices before a final purchase decision is made (Lee et al., 2019). This crucial shift from a transactional to an experiential function automatically underscores the urgent need for digital representation that is not only visually accurate but also socially and demographically inclusive throughout the entire process of consumer interaction (Raymond et al., 2024).

The core research problem of this study specifically emerges from the persistent and unresolved challenges of visual representation within the modern online shopping ecosystem. Consumers are faced with a "representational gap," a



condition where static product images, typically displayed on a single model with one type of skin tone and body type, utterly fail to provide an accurate and reliable depiction of how the garment will look and feel on their own unique skin tone. This fundamental problem, where a mismatch occurs between the product image and the consumer's self-image, directly and negatively affects consumers' confidence in their purchasing decisions (Chen et al., 2020), significantly increases the potential for product returns which are detrimental to both seller and buyer (Li et al., 2021), and ultimately hinders the creation of a truly fair and inclusive shopping experience.

The specific research gap that this study aims to address lies precisely in the domain of accessibility of fashion visualization technology for the broader public. A review of the current scientific debate shows that the main focus in developed countries is consistently on the development of highly sophisticated, high-tech fashion solutions. Leading researchers in France and the United States, for example, are at the forefront of developing complex Artificial Intelligence (AI) and Augmented Reality (AR) algorithms to create virtual try-on applications with hyper-realistic fidelity (Palmas et al., 2021). Meanwhile, various research institutions in Germany focus their efforts on formulating technical standards and data security for the use of digital avatars, while industry practitioners in Turkey are busy integrating complex 3D design software into their manufacturing workflows (Genay et al., 2021). However, it should be noted that all these cutting-edge solutions are fundamentally capital-intensive and require high technical expertise (Singh & Kismawadi, 2025), thereby creating a deep accessibility gap for small-scale designers, MSMEs, and fashion educators.

It is in this context that the Scratch platform, an innovative, fully block-based visual programming environment developed by the Lifelong Kindergarten Group at the Massachusetts Institute of Technology (MIT) Media Lab, emerges as a highly relevant alternative solution. Scratch's main advantage is its remarkably intuitive interface and drag-and-drop approach. This fundamental characteristic effectively democratizes access to the digital creation process, a philosophy rooted in the theory of constructionism, which remains relevant and adapted in modern education to encourage active learning through creation (Levin et al., 2025). The platform has been widely proven as an effective educational tool for developing computational thinking (Bocconi et al., 2016) and as a medium for rapid prototyping in various fields (Touri et al., 2019), as it offers the flexibility to visualize complex ideas in an accessible format. The potential of Scratch as a tool to address the "representational gap" is the foundation for formulating this study's research objectives (Liu et al., 2025).

Based on the conceptual framework and research gap described, this article establishes a series of specific research objectives. First, to develop a functional prototype of an interactive digital fashion catalog using Scratch, with the main functionality of simulating the matching of apparel on two different skin tone variations. Second, to identify and map the key stages in the design and construction process of the project. Third, to analyze the effectiveness and functionality of the resulting prototype by evaluating user interactivity and the success of the visual simulation as an engaging and practical "game" catalog concept.

## 2. Methodology

This study adopts the ADDIE (Analysis, Design, Development, Implementation, Evaluation) Instructional Design framework as the primary methodological approach. The researcher selected this model due to its systematic and iterative nature, making it highly relevant for guiding the design, development, and evaluation process of a technological prototype such as an interactive digital fashion catalog. A qualitative approach serves as the foundation of this study, enabling the researcher to delve into a deep understanding of the participants' perceptions, experiences, and assessments regarding the visual representation problem and the proposed solution. All collected qualitative data were then analyzed using thematic analysis techniques to identify relevant patterns of meaning. This research process is structured into three main stages as follows:

### 2.1 Analysis Stage

In this initial stage, the researcher conducts the identification and validation of the core problem, namely, the "representational gap" in the context of online fashion catalogs. The researcher analyzes relevant literature on virtual try-on technology, inclusivity in fashion, and the potential of low-fidelity platforms like Scratch. Simultaneously, the researcher conducts preliminary interviews with experts to confirm the urgency of the problem in the Indonesian market and to establish the essential functional requirements for the prototype to be developed. The outcome of this stage is a validated problem statement and a clear set of design criteria.

### 2.2 Design Stage

Based on the analysis results, the researcher designs the conceptual and technical blueprint for the digital fashion catalog prototype as illustrated in Fig. 1. This stage includes the design of the user flow, user interface (UI), and the specification of visual assets. The researcher specifically designs two avatar models with representative skin tone variations and several digital fashion items (example: kebaya) as the main assets. Additionally, a block-based programming logic structure is designed to govern the mix & match mechanism between the fashion items and the avatars. The outcome of this stage is a comprehensive design document, including visual storyboards and logic flowcharts.

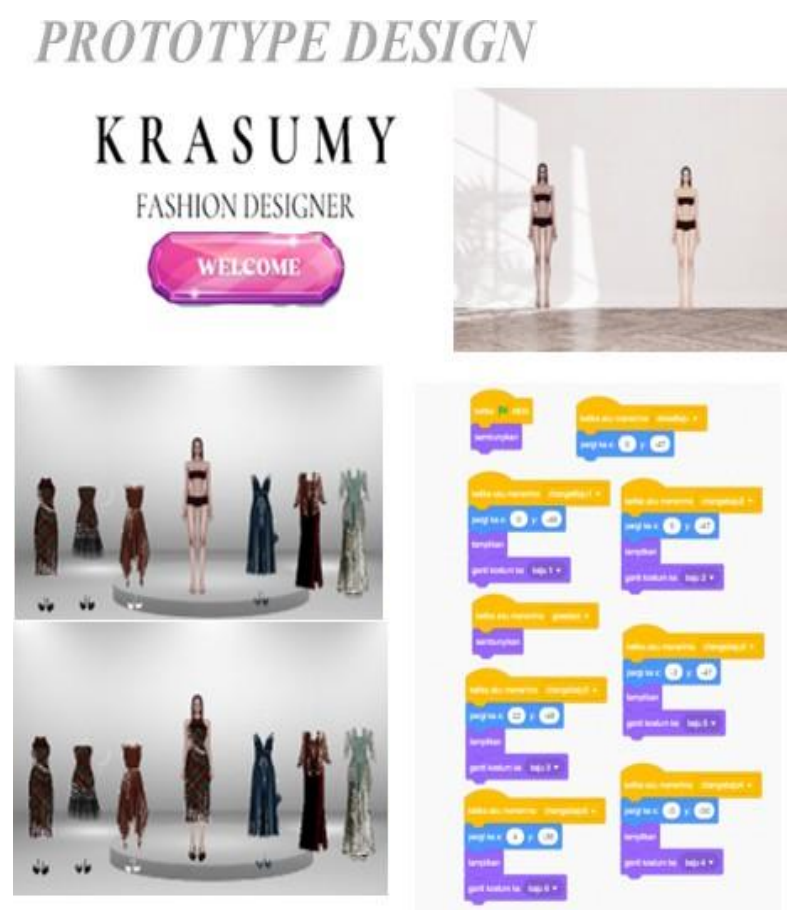


Fig 1: Prototype design

2.3 Development Stage

In this stage, the researcher constructs the functional prototype based on the previously designed blueprint as shown in Fig. 2. The researcher translates the entire design plan into the Scratch visual programming environment. This process involves the creation of sprites (graphic objects) for each avatar and fashion item, as well as arranging sequences of code blocks to implement the interactivity logic. The researcher ensures that the main functionality namely, the user's ability to select a fashion item and see it dynamically applied to both avatar models runs according to the design.

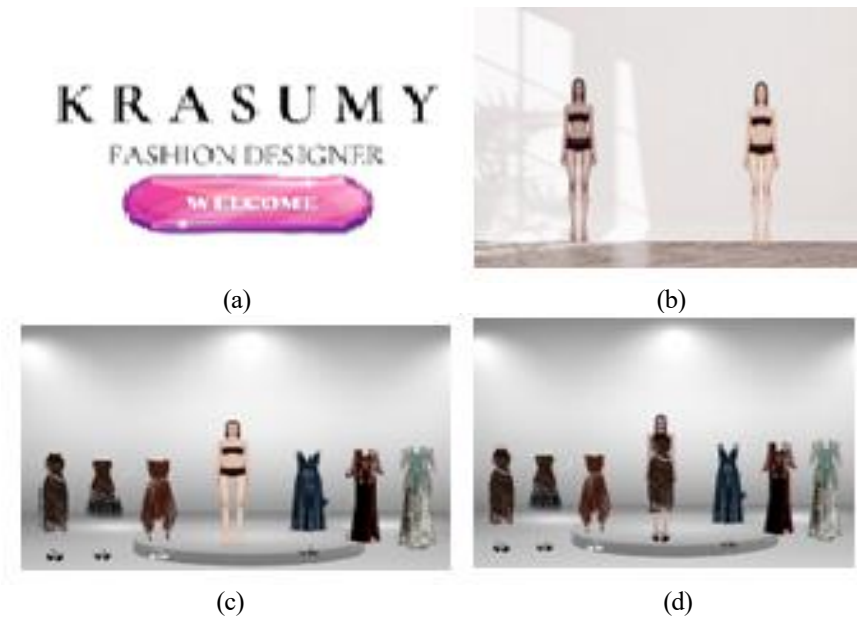
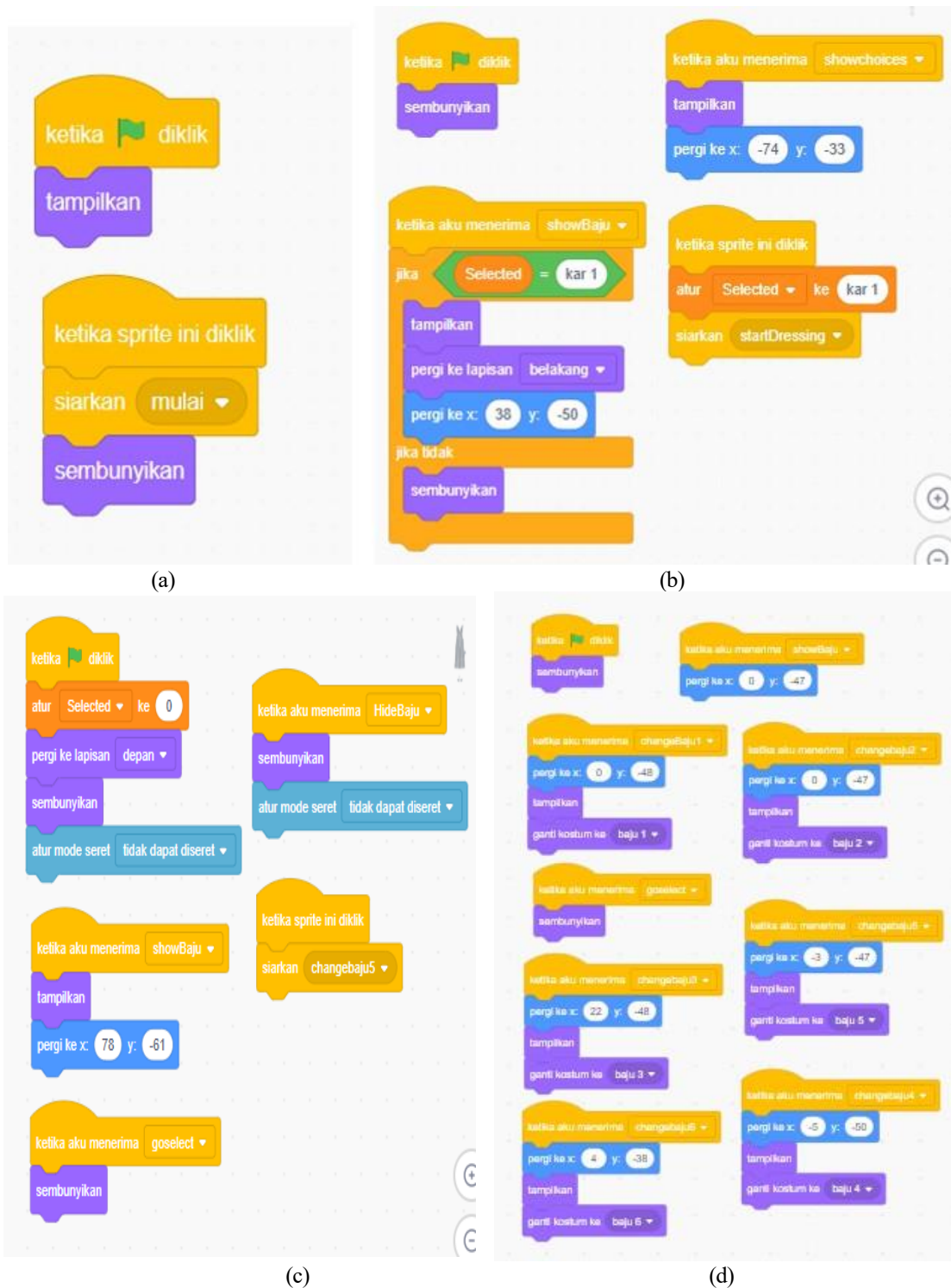


Fig 2: (a) Main menu page; (b) Skin tone selection; (c) Apparel selection; (d) Apparel fitted on the model.

In this study, the outcomes of the discussions held during the design phase served as a guide for the creation of the software and instructional materials for the digital game. The Scratch platform was used to code the digital game and create an application, in accordance with this study's development strategy. Every development undertaken went through constant testing to ensure that the digital game runs smoothly and effectively. The drag-and-drop mechanism, color palette selection, and dress counters in each interactive component are controlled through block-based coding on Scratch, as shown in Fig. 3.



**Fig 3: (a) Coding for the main menu/start game; (b) Coding for the skin tone selection page; (c) Coding for the apparel collection; (d) Coding for applying apparel to the illustrator model.**

### 3. Results and Findings

This section presents the factual findings obtained from the thematic analysis of interview data with three key respondents (R1, R2, and R3). The backgrounds of the experts who participated in this study are detailed in Table 1. Table 1 presents the background and expertise of three female respondents, each with over five years of experience in their respective fields. Respondent R1 is an industry expert, serving as the Co-Founder and CEO of a local fashion brand, with 15 years of experience in business strategy, market analysis, and fashion supply chain management. Respondent R2 is a practitioner and owner of an independent fashion label categorized as a micro, small, and medium enterprise (MSME), with 8 years of hands-on experience in design, small-scale production, and direct-to-consumer marketing. Respondent R3 is an academic, working as a lecturer and researcher in Interactive Media Design, possessing 9 years of experience in Human-Computer Interaction (HCI), gamification, and the application of low-code platforms in education.

**Table 1: Respondent background and expertise**

Respondent Code	Gender	Profession and Institution	Expertise and Experience (≥ 5 years)
R1	Female	Industry Expert: Co-Founder & CEO, Local Fashion Brand	15 years of experience in business strategy, market analysis, and fashion supply chain management.
R2	Female	Practitioner: Fashion Designer & Owner, Independent Label (MSME)	8 years of experience in the conceptual design process, small-scale production, and direct-to-consumer marketing.
R3	Female	Academic: Lecturer & Researcher, Interactive Media Design	9 years of experience in Human-Computer Interaction (HCI) research, gamification, and the use of low-code platforms for education.

#### 3.1. Consensus on the Urgency of the "Representational Gap"

The interview analysis confirms a strong consensus regarding the failure of current e-commerce to represent products inclusively. Respondents from all three backgrounds agreed that standard practices create significant problems. From a business perspective, R1 (CEO) emphasized the financial impact, stating, "This is no longer just a social issue; it's a business issue," and, "Every time a consumer hesitates because they can't imagine the product on themselves, that's a lost potential sale. Worse, if they take the risk and buy it, and it doesn't suit them, it becomes a return cost that burdens our margins.". From a practitioner's point of view, R2 (Designer) highlighted the impact on customer relationships and trust, revealing, "For a small label designer, trust is everything. When a customer asks 'do you think this will look good on my tan skin?', that's a signal my product photo has failed. This 'representational gap' creates an emotional burden and doubt that technology should be able to solve.". Meanwhile, R3 (Academic) provided a theoretical lens, "What we are seeing is a system failure in managing user expectations. A non-representative interface creates cognitive dissonance, which directly harms the user experience and trust in the platform.".

#### 3.2. Positive Evaluation of Prototype Functionality and Usability

When interacting directly with the prototype, the three key respondents gave a very positive initial response, focusing on its functionality and simplicity. R2 (Designer) highlighted the prototype's practical value: "This is brilliant. I don't need a manual, I don't need to think. Click a character, click a dress, and it appears instantly. This answers 90% of my customers' basic visual questions without any hassle.". The functionality of matching apparel on two skin tones was deemed highly effective as an initial concept. R1 (CEO) viewed it from a strategic standpoint: "Even with just two skin tones, this has already proven a concept at almost zero cost. This is a very effective market research tool.". From a usability perspective, R3 (Academic) concluded, "The prototype's interface is rated as highly intuitive and easy to operate. Its interaction uses the universal 'point-and-click' metaphor, so users don't require special guidance and can focus on the experience of trying on clothes.".

#### 3.3. Validation of the Platform's Potential and Future Development Directions

Interview data indicates that the experts rate the potential of low-code platforms like Scratch very highly. For small-scale designers, the platform is considered a "game-changer" that democratizes innovation by enabling the visualization of ideas without requiring expensive high-end technology. For educational purposes, it is seen as an outstanding pedagogical tool for teaching interactive design logic and visual problem-solving. Despite the praise, the respondents also provided several consistent constructive suggestions for future development. A summary of the key questions asked during the interviews and a synthesis of the experts' views are presented in Table 2.

**Table 2: Summary of key questions and synthesis of expert views**

No	Evaluated Aspect / Key Question	Synthesis of Expert Views
1	"After interacting with this prototype, what is your first impression of this Scratch-based interactive catalog concept?"	The respondents gave a very positive first impression. The prototype was deemed functional and effective due to its simplicity. A respondent from the practitioner group (designer) described it as "brilliant" because it could answer basic visual questions from customers without complexity.
2	"In your opinion, is the functionality of matching apparel on two skin tone variations effective enough as an initial step to address the representation problem?"	This functionality was considered highly effective as an initial concept. Although it only provides two skin tone variations, it was deemed sufficient to prove the concept at a minimal cost and was seen as an effective market research tool.
No	Evaluated Aspect / Key Question	Synthesis of Expert Views
3	"From a usability perspective, how intuitive are the interface and interaction flow we presented? Were there any parts that felt confusing or difficult?"	The prototype's interface was rated as highly intuitive and easy to use. A designer (R2) stated they did not need a manual to operate it. An academic (R3) also affirmed its intuitive interaction, as it uses the universal "point-and-click" metaphor and deliberately ignores non-essential visual details to focus on testing core functionality.
4	"How do you rate the potential of a low-code platform like Scratch as a rapid prototyping tool for small-scale designers or for educational purposes in the fashion field?"	Very important. Coastal batik or hijab options will make it feel relevant. Its potential was validated very strongly by the respondents. For small-scale designers, the platform is considered a "game-changer" that democratizes innovation by enabling the visualization of ideas without requiring expensive AR technology. For education, it was rated as an outstanding pedagogical tool for teaching interactive design logic and visual problem-solving.
5	"What constructive suggestions or critiques can you provide for the further development of this prototype to make it more functional and relevant?"	The respondents provided several consistent constructive suggestions for future development. These suggestions include: • Enhanced Scalability and Representation: Adding a broader spectrum of skin tones and variations in body shapes. • Improved Visual Detail: Including the ability to display visual representations of basic fabric textures (like cotton or satin). • Increased Interactive Features: Integrating external asset libraries or using variables and sliders to allow for real-time color customization.

## 4. Discussion and Implications

This section interprets the findings presented above, discusses their significance, and links them to relevant theoretical frameworks and academic literature.

### 4.1. Implications of the "Representational Gap" from an Academic Perspective

The finding that the "representational gap" impacts both business and consumer psychology corroborates various existing theories. The financial impact of product returns due to visual inaccuracy, as mentioned by R1, is a well-documented operational efficiency problem in e-commerce literature (Rus et al., 2024). The consumer doubt described by R2 is a clear manifestation of "perceived risk," a key barrier in online shopping adoption discussed. Furthermore, the cognitive dissonance identified by R3 is a core psychological concept explaining why a poor user experience can lead to technology rejection and a breakdown of trust (Fu et al., 2022).

### 4.2. The Value of Low-Fidelity Prototypes in the Context of Innovation and Design

The prototype's success in proving a concept with minimal resources connects strongly to the principles of Lean Startup and the Minimum Viable Product (MVP) (Schuh et al., 2018), where rapid and inexpensive idea validation is prioritized over developing a complex, perfect product. The success of this low-fidelity prototype also supports the argument that interactivity and user empowerment are often more critical than photorealism in the early stages of technology adoption, a point frequently made in the journal *Computers in Human Behavior*. Additionally, the intuitive interface is a pillar of user-centered design, which aims to reduce cognitive load and create a seamless and satisfying user experience.



### 4.3. Democratization of Technology and Future Research Directions

The potential for technology democratization highlighted by the experts reflects the spirit of the maker culture movement and the theory of constructionism (Lachney et al., 2020), which views technology as an expressive tool that should be accessible to everyone, not just experts. This finding offers an important counter-narrative to the industry's tendency to focus on expensive and exclusive high-tech solutions. The constructive suggestions for future development effectively map out paths for future research. For instance, the request for richer representation (more skin tones and body types) points toward studies on inclusive and parametric avatars, a trending topic in journals such as ACM Transactions on Graphics and Virtual Reality.

## 5. Conclusion

This study successfully proves that a low-fidelity platform like Scratch can be effectively used to develop a prototype of an interactive digital fashion catalog to address the "representational gap" problem in e-commerce. Findings from interviews with industry stakeholders confirm that the lack of inclusive visual representation is a significant problem that negatively impacts consumer trust and business efficiency.

The developed prototype was validated as an effective initial solution, with its simplicity and intuitive interaction being its main strengths. Moreover, this research affirms the great potential of this approach as a tool that democratizes technology, empowering small-scale designers to innovate, and serving as a practical learning medium in the field of fashion education. Nevertheless, for future development, an enhancement of richer representation is recommended, such as adding a broader spectrum of skin tones, variations in body shapes, and fabric texture simulations to improve visual accuracy. This study concludes that accessible and user-centered innovation plays a crucial role in creating a more inclusive digital fashion ecosystem.

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## Conflict of Interest

The authors declare no conflict of interest

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