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ECOCHILDCLO: A MOBILE APPLICATION FOR CUSTOMISATION OF CHILDREN'S CLOTHING TOWARD SUSTAINABILITY

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Abstract. Some retailers provide global platforms for customised women's and men's clothing; however, the fit size of children's clothing remains a concern. This research attempted to find sustainable solutions to design problems affecting non-fit children's clothing based on an awareness of the need to reduce post-consumer waste. EcoChildClo is a clothing design mobile application that will help to quickly and easily create designs for children aged one to 12 years old. The EcoChildClo mobile application was developed using MIT App Inventor. This research reported the six phases of the Multimedia Development Life Cycle: concept, design, obtaining content material, assembly, testing, and distribution. The mobile multimedia was built using the JavaScript ES2015 programming language as the authoring tool during the assembly phase. This application can show previews of clothing samples, flat sketches, and made-to-measure flat patterns. Comparative analysis between various apps currently available on the market and the developed application determined that EcoChildClo is properly-suited and better equipped for making the basic blocks of custom children's clothing. Anybody using this application would be able to customise children's clothing according to an individual's height, body measurement, and body shape. Moreover, improved customisation of children's design and fitted garments would reduce the amount of children's clothing going to household waste.

Keywords: *Childrenswear, clothing mobile application, post-consumer waste, customised clothing, sustainability, apparel industry.*

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1. Introduction

In the clothing and apparel business, production is fast evolving into a high-tech activity because of the rapid growth of technology, so design, pattern making, cutting, and manufacturing are improving. These are some of the fastest-growing sectors of the clothing manufacturing industry. As a result, clothing industry experts and researchers must have the necessary resources to match the rapid pace of change required to produce truly competitive garments. Nowadays, clothing manufacturing companies can easily use mobile applications to sell finished products. Moreover, most of these applications are easily discovered with Google Play Market's search engine, making them easy to access (Jalil & Shaharuddin, 2021; Zhylenko *et al*., 2019). Zhylenko et al. (2019) investigated the categories of clothing industry mobile applications. According to their findings, the percentages of these apps supporting the fashion distribution

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industry are as follows: 40.3% galleries of ready-made clothing patterns, 27.7% online shops apps, 20.0% galleries of clothing styles, and 2.9% apps to create a capsule wardrobe. The remaining 6.3% have been developed as apps to enable, for example, the creation of sketches in fashion design (0.57%), clothing colour matching (0.3%), and the saving of client measurements (1.14%) (Zhylenko *et al.*, 2019). Almost half of these apps might be utilised in clothing creation, as they feature galleries of clothing patterns that could be employed in the process. On the other hand, these designs focus on fashion trends and are often in unidentifiable sizes. Although they can guide the fundamental flat patterns, they cannot be utilised to produce high-precision customised clothing design (Zhylenko *et al.*, 2019).

Moreover, various fashion business applications - for instance, Stylebook, Cloth, and Polyvore - have been studied by researchers. These applications contain galleries of clothing models but only for a limited range of fashion trends, and their sizing ranges are unidentified. One issue is that they only focus on women's clothing categories, so they cannot be utilised as a reference for developing clothing of similar design types along the lines of gender or for other categories like men's or children's clothing. It is recommended that when creating such applications, researchers adopt a design methodology that is straightforward, easily accessible, and known to as wide a range of users as possible. Furthermore, no approach has yet been developed to transform children's body size into the appropriate flat pattern shapes and draft them (Saaludin *et al.*, 2020). According to Jalil and Shanat (2022), children has different body shape and silhouette that should be considered in the pattern-making properly and drafting this drafting needs some extra information and details for measurements. Schofield (2007) stated that the disparities between anthropometric measures and children's size charts contribute to discrepancies between the clothes and the children's body shape. A mobile application that allows users to explore the sizes they may want to purchase, or produce would be beneficial to reduce post-consumer clothing waste and alleviate overconsumption concerns. This research would also significantly impact consumption and waste management because children will be able to wear certain well-fitted clothes for substantially longer periods. The need to acquire items to replace still-new garments would reduce outgrown or ill-fitting in landfills due to their inability to fit the body properly. The advanced and convenient programming language, JavaScript ES2015, was used to create the current application. Figure 1 shows the research framework.

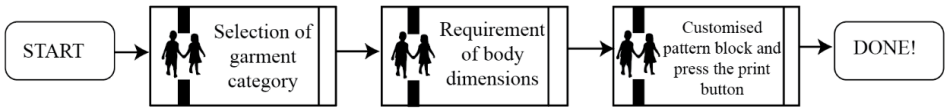


Figure 1. Research framework

2. Literature Review

2.1. Technology, Mobile Application and Clothing Industry

As a result of rapid technological advances, the clothing industry is swiftly transitioning from its labour-intensive and mechanically simplistic roots to become high-tech and capital-intensive. The rapid advancement of technology has contributed to the development of high-quality design, cutting, stitching, and finishing techniques. Clothing designers are increasingly adopting pattern cutting from blocks or adapting

existing patterns due to the accuracy and speed range generated (Chin *et al*., 2018). Several technological methods can be used to calculate the basic block pattern parameters: (1) a pattern design system (PDS), (2) a spreadsheet tool, Microsoft Excel, or (3) an electronic calculator in a specific mobile application. Comparing these methods requires consideration of the primary factors that are important for every pattern maker, whether self-employed or working in a small business. Henceforth, these parameters - speed, precision, cost, and ease of use - must be incorporated into any technological approach, especially in regard to mobile application creation (Zakharkevich *et al*., 2021). Zakharkevich et al. (2021) stated that a mobile application would be a fantastic tool for clothing designers, accelerating their work rate while making their operations more convenient and up-to-date. It would be valuable for garment manufacturers, allowing them to design and produce clothing for children that is tailored to their needs. Zakharkevich et al. (2021) investigated fourteen types of mobile applications used in the clothing and apparel industry. The most popular categories of such apps are as follows: "Galleries of ready-made clothing patterns", "Online shops apps", and various "Galleries of clothing styles" (Zakharkevich *et al*., 2021). In addition, Zhylenko et al. (2019) stated that the Android operating system had made the greatest contribution to all the categories because of its wider availability.

2.2. Children's Clothing Design and Difficulties

Sizing (grading) children's clothing is an issue in the apparel business because many retailers offer a global shopping platform. Inconsistent clothes sizing can lead to youngsters being dissatisfied with the fit of their clothes (Jalil & Shanat, 2022) and unable to determine what size best suits them based on their body type (Shaharuddin & Jalil, 2021). According to a study by Gill (2015), advances in computer technology have significantly contributed to the sizing and fitting of clothes. Computer-Aided Design (CAD) and Computer-Aided Management (CAM) systems to develop more accurate patterns and virtual try-ons have become integral to the development and evolution of sizing in the apparel industry (Dove, 2020). Dove (2020) pointed out that it may be difficult for a 3D scanner to accurately determine waist heights for oval body shape participants. Furthermore, technical developments in body scanning and virtual fitting rooms have not addressed the underlying problem of clothing sizing; instead, they utilise the final product or body avatar and then fit mass-produced apparel onto this form (Dove, 2020). Moreover, Pattern Design Systems (PDS) are crucial tools for designers since they allow work to be performed more quickly. Nevertheless, Zhylenko et al. (2019) stated that a PDS is a costly instrument that not all clothing designers can acquire. A PDS often requires specific peripheral devices, such as plotters or digitisers. Furthermore, it is necessary to understand how a PDS operates in order to use it (Zhylenko et al., 2019). However, college and university curricula have featured courses devoted to studying the PDS in the last fifteen years.

2.3. Customised Children's Clothing and Sustainability

Customised clothing is usually, but not always, created by drafting blocks of specific patterns. Furthermore, Ashdown (2013) maintained that most trainers and designers know little about the technical aspects of children's clothing design, such as traditional and computer-aided pattern-making, as well as grading and attaining the proper fit and proportions in children's clothing. As a result, according to Ashdown (2013), the clothing industry is seeking ways in which apparel can be suited to body

shapes, especially for children. Hence, this industry is seeking a solution to fit clothing based on children's body types. According to the international size charts, Jalil and Shanat (2022) demonstrated that different body shapes often do not follow regular market sizes, while children's sizes can be recognised effectively by understanding their body silhouettes, age, height, and weight. Therefore, children's clothing can be customised with a specific height range, body measurement and body shape. Therefore, precise information might be used to design and buy children's clothing sustainably, preventing the rise of post-consumer waste resulting from creating children's clothing (Jalil & Shanat, 2022). Reduce or zero waste policy supports every phase of the sustainability movement and is considered a key stepping stone to sustainability (Jalil & Shaharuddin, 2021); in this research, this part of the sustainable development goals has been deemed. Moreover, Bougourd and Treleaven (2020) stated that since no complete review had been developed from anthropometric body measurements, most clothing firms used "ready-to-use data".

Meanwhile, disconnects between anthropometric measures and size charts have contributed to disparities between clothing and its intended wearers (Schofield, 2007). Therefore, it is challenging to make clothing for various body shapes, particularly for growing youngsters (Shaharuddin & Jalil, 2021). Most up-to-date size charts available are based on anthropometric measurements, whereas it is necessary to identify the correct size to ensure a good fit (Jalil & Shaharuddin, 2021). However, the fundamental difficulty with all size charts and anthropometric data is that children's bodies constantly change, rendering the measurements obsolete and resulting in a wide range of shape and size variations amongst children (Pechoux & Ghosh, 2002). Saaludin et al. (2020) stated that purchasing clothes of the wrong size means spending time returning and exchanging them; in fact, these clothes are generally considered unwanted and become post-consumer waste. Numerous schemes, such as 3D virtual try-ons, have been introduced to reduce the return and interaction of clothes of the wrong size by overcoming fit and sizing issues (Balach *et al.*, 2020). Additionally, several start-up businesses, such as 'Virtusize' and 'True-fit', have used different principles to assist customers in clothing decision-making (Edmir, 2017). Moreover, some companies use online consumer body type history to recommend the next purchase size. The online company 'Virtusize' allows buyers to determine the proper size based on measurements and clothing descriptions. Although businesses and mass production operators exploit this platform, Jalil and Shanat (2022) explored that it has not been fully introduced in the domestic production of children's clothing. As mentioned, children's clothing always encounters fit issues since children's bodies range widely in height and weight for reasons connected to genetics, diet, and other environmental factors (Tongue *et al*., 2010). To avoid bad publicity, returns, complaints, and decreased sales due to poor fit, retailers should constantly prioritise their clothes' quality and fitting size parameters. Consequently, this study aimed to develop a mobile application that customises children's clothing with personalised sizes. The app determines the ideal dimensions for fitting that may meet the needs of children's bodies, either domestically or industrywide.

3. Methodology

The Human-Centred Design Approach was used to reveal the best design and user experiences that may be used to assist people. In-depth research on the existing procedures and organizational structures was undertaken in the preliminary phase of this

project. The problems explored in this project were, firstly, the excessive clothing waste that occurred during the post-consumer consumption phase, and the second problem was the disappointment of parents who had been unable to purchase customised children's clothing, whether they were buyers or professional garment makers. Consumers of children's clothing have been highlighted as a potential target market. The human-centred design process is divided into three distinct sections: *Inspiration*, *Ideation*, and *Implementation*. In the preliminary research phase, *Inspiration* was gathered by searching for and understanding the existing ways in which people (parents, designers, and educators) interact with children's clothing pattern-making, as well as their purchasing and designing difficulties. The information on the inspiration phase was applied in the Ideation phase. Hence, the user experience and mobile application design concepts strive to improve the accuracy of children's patternmaking and drafting of clothing items and decrease the time on task for creating the pattern's outfit. Therefore, the solution of the results related to the customisation of children's clothing, especially in pattern making in the existing manual methods, was evaluated to determine the best focus areas for design solutions. The user experience and mobile application design concepts strived to improve flat patternmaking as a sustainable solution by considering children's bodies and accurate measurements. These influences and design theories were then used in the *Implementation* phase, in which a working digital mobile prototype was employed to generate customised children's clothing for any user instead of focusing on mass production and the fast fashion industry.

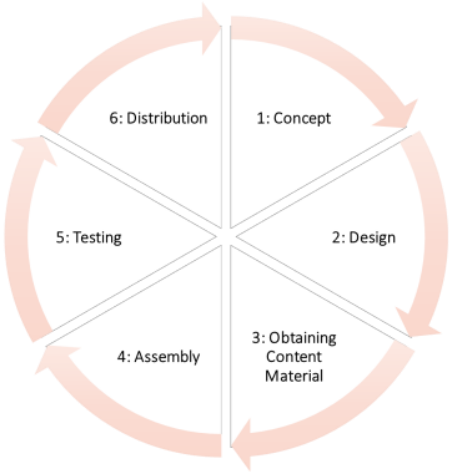


Figure 2. Multimedia Development Life Cycle (MDLC) Methodology (Sutopo, 2003)

This research followed a system development approach by utilising and developing the Multimedia Development Life Cycle. According to Sutopo (2003), if multimedia development is considered the main objective while creating an interactive multimedia application, the development method, which was abbreviated MDLC (Multimedia Development Life Cycle), is suggested to be implemented for this purpose. The MDLC contains six stages of development, starting from the Concept, and moving to Design, Obtaining Content Materials, Assembly, Testing, and Distribution (Figure 2). The following section describes the steps of the Multimedia Development Life Cycle (MDLC) (Sutopo, 2003).

Concept: In this stage, the goal of the software and its future users were determined (audience identification). The program's eventual goal is to convey an organization's unique identity to the end user through the subtleties of multimedia. The application size, intended audience, and other design parameters are also established at this stage. Designing children's clothing of customised sizes was the goal of this program. The application concept was described as follows:

- *Title:* Customised children's clothing.
- *Type:* Pattern making.
- *Platform:* Mobile Android.
- *Audience:* Individuals, designers, dressmakers, tailors, educators, and retailers.
- *Interactive:* allows users to design and print flat pattern children's clothes on a scale ten times larger.

Design: In this stage, the specifications of the program's structural design, style, appearance, and material requirements were completed, as are the specifications of the program's functionality. These specifications were as precise so that the next stage, the acquisition of content material and assembly, progresses as smoothly as possible.

Obtaining Content Material: This is the stage in which the resources relevant to the project's goal are gathered. Clip art pictures, photos, animations, and videos are only some of the free or paid-for elements that can be obtained to align with the design. Assembling the product can be performed in parallel with this step.

Assembly: Obtaining content material can sometimes be completed concurrently with the assembly stage, as mentioned previously. In some instances, however, the material acquisition and assembly stages will be conducted linearly. The software construct was used to produce the items or materials gathered.

The following section presents in depth the processes of detailed design, obtaining the content material, and assembly. The purpose of this project was to find a way in which children's clothing patterns could be designed based on an individual's size. The current paper used the patternmaking system M. Müller & Sohn technique to create basic blocks named the "Basic Pattern," from which all the other patterns could be created. The M. Müller & Sohn technique was developed by Michael Müller in Munich, Germany, in 1891 that patterns are drawn by a combination of basic blocks (Kılıc, 2011). This project involved four particular types of clothing: top, pants, skirt, and dress. The other fifteen patterns were created from these four specific pieces, so a total of nineteen clothing designs were programmed in this application; however, these nineteen designs also covered sixty-six clothing designs. In other words, the childrenswear was made from any combination of these nineteen patterns and only programmed using these nineteen patterns, while the user had no access to their design patterns; however, the patterns could be combined. All the clothing templates were based on geometric vectors designed manually and then digitally using Adobe Illustrator CC 2021. In total, twenty-one tops/shirts, four skirts, four pairs of pants and sixty-six dresses were created in this application based on the different combinations of the nineteen primary patterns.

In the modelling stage, these nineteen primary patterns became the basic blocks of fixed data written during the programming and the basis on which the sixty-six clothing items were designed. However, a group of data reported according to children's body sizes and gender could be used to make customised designs. Hence, the patterns were changed automatically.

1- For this purpose, the software was designed such that, in the first step and once the user enters the application, they identify the type of clothing or pieces needed: top, skirt, dress, or pants. Adobe Illustrator CC 2021 was employed to create all the vector sketches for the programmer's work.
2- After selecting the type of garment piece by clicking on it, the user enters the second step, in which the user can see all the subset photos based on the styles of the main pieces. When the user chooses each item of clothing, the front and back can be seen in the flat sketch design view; the confirmation button is then clicked to continue. For example, if the user chooses a top in the first stage, all types of tops appear in the second stage. The user will see the front and back views and choose one based on their requirements.
3- Following the user's selection of the clothing type, they enter the next stage, where they can customise the pattern by entering the size of their children and sometimes their trust in the standard chart size since the pre-programmed patterns are based on this standard chart size. At this stage, the user may write their child's name and specify their gender because children's measurements are different in some cases. The user then clicks on the child-size button; the eight different sizes are based on the child's height and weight, from which the appropriate size can be found for the child. If the user does not know the child's measures or how to take them, the user can click on the measurement guide and check the photo guide provided on this page.
4- Finally, after checking the child's size, the user specifies the amount of seam allowance that should be arranged (between 1.5 cm and 3 cm) and then hits the confirm button. In the last step, based on the selected clothes, the pattern is modified according to the child's size, and the user sees the patterns with different seam allowances and agrees by clicking the confirmation button for the PDF output. The exported pdf file should be printed ten times larger for it to be used for further action.

Testing: Following the application assembly, the testing involves executing the application program and checking to identify any errors. The developer may ensure that all the data has been entered correctly by completing the application/program and checking for problems. Moreover, the ISO 9162 test determines the viability of media goods once they have been manufactured and assessed. According to Al-Kilidar et al. (2005), ISO 9126 is an international standard intended to ensure the quality of all software-intensive products, including safety-critical systems where lives are at risk if software components fail. External systems quality is operationalised by six characteristics: functionality, reliability, effectiveness, usability, maintainability and portability (Sutopo *et al.*, 2019).

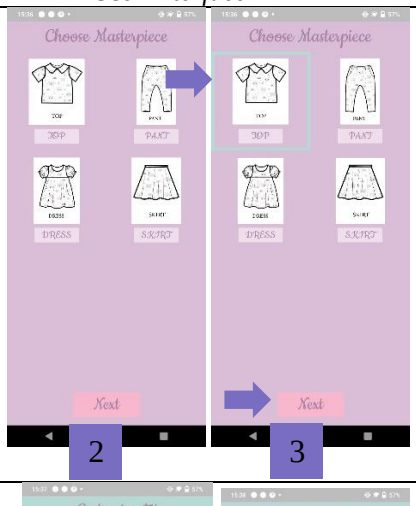
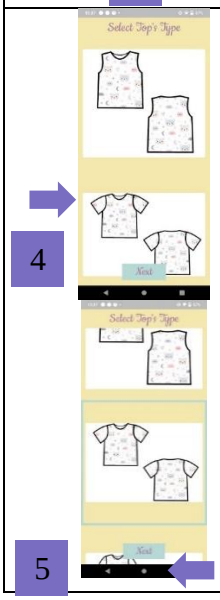
- **ISO 9126:** The assessment standard for children's clothing media software was met successfully. The testing phase in the development of EcoChildClO used the ISO 9126 testing standard. This project evaluated two of the six characteristics of ISO 9126, usability and functionality (Saputra *et al.*, 2020). The former assessed the ease of use of applications, while the latter evaluated the functions contained in making customised pattern applications. The aim was to identify and highlight the usability issues when using apps. However, the modification of the software (maintainability), transfer of the software to another environment (portability), and efficiency and reliability were not the aims of this study, according to Moumane et al. (2016).

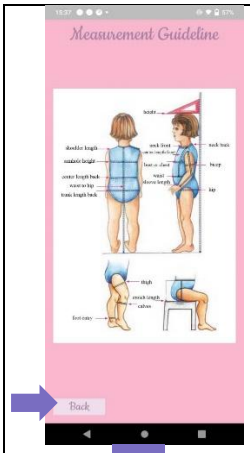
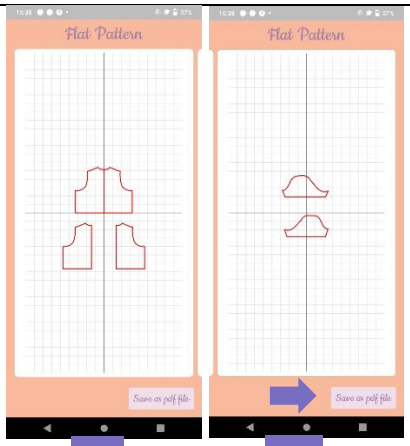
Distribution: The application was reproduced and delivered to end users in the distribution stage.

4. Findings and Discussion

Table 1 shows the findings and their explanation in detail. In the first stage, the concept and initial application design were proposed, the result of which was used as a reference for the application development. Since the application was developed for Android devices, it can be used on smartphones that use the Android operating system. The development also involved facilitating the use of the application by making option buttons available on every page. The information in the mobile application was also made easily understandable by loading images into the application pages.

Table 1. Description, Application Concept and Development

Design and Concept			
User Interface	*Description*	*User Interface*	*Description*
	Page Sign Application Display. This page is the first page when the application runs (1).		Page Main Menu. This page will display four options to the user (2). They start with pieces that users can choose and press "**Next**" to proceed (3).
	Page of Features provided in Application. After selecting a piece, all types originating from the selected piece are displayed (4); the user can choose (5) and press "**Next**" to proceed.		Page of Customisation. Users can customise the kid's measurement (6) and type their name based on gender and size, and if they are not sure about measurements may press "**More**" to help (7). and press "**Next**" to proceed.

 8	Page of measurement guideline. This feature helps the user take measurements and write in boxes to customise the fit due to having detailed and specific measurements based on body types, and press "**Back**" to proceed.	 9 10	Page of preview of flat pattern in the application. Users may look at pattern (9) and press "**Save a pdf file**" to export in pdf file in 1/10 scale and plot customised patterns (10x).

An application prototype was developed for testing, which was conducted in the developer environment by incorporating user samples. The users considered the application through the questionnaire media. The questionnaire results can be used to conclude whether the built application met the objectives. Tests were conducted with several application users via a questionnaire. Hence, the following steps were for experts and individuals to evaluate the app prototype using semantic differential scales before processing the questionnaire results. Questionnaires were distributed to twenty-four respondents (eight fashion and clothing students, four lecturers and experts, five designers working in children's clothing production and seven mothers) to discover the responses and ratings of users of this application with some statements for evaluating that were displayed in Table 2. The statements were adopted from Sutopo et al. (2019)'s study which measurement items were based on a four-point Likert scale to enhance means and standard deviations. Respondents could indicate their attitudes by selecting "strongly disagree," "disagree", "agree," or "strongly agree" for each measurement item, which was computed as 1, 2, 3 and 4 separately. The questionnaire was sent to the participants through the Telegram platform, and a QR code was provided so that they could download the application through Google drive. As shown in Figure 3, the questionnaire results were calculated to assess the application prototype.

From the respondents' results, it can be concluded that the application had been made user-friendly (mean = 3.92), easy to use (mean = 3.88), easy to understand (mean = 3.83) and implement (mean = 4), so it was expected that it could help users who want to design and customise children's clothing in the future. Moreover, the good functionality score among respondents (mean= 3.58 out of 4) shows that children's clothing applications need to support people's real-world requirements; designing clothing mobile applications without purpose may be fun but not useful. The last part of the questionnaire asked anyone using the application to make pieces if they would share their photos and results with the researcher for further investigation. The low scores listed by respondents were considered to refer to ways of improving the prototype. Therefore, considering all the prototype's advantages and disadvantages, the mobile application was designed and developed.

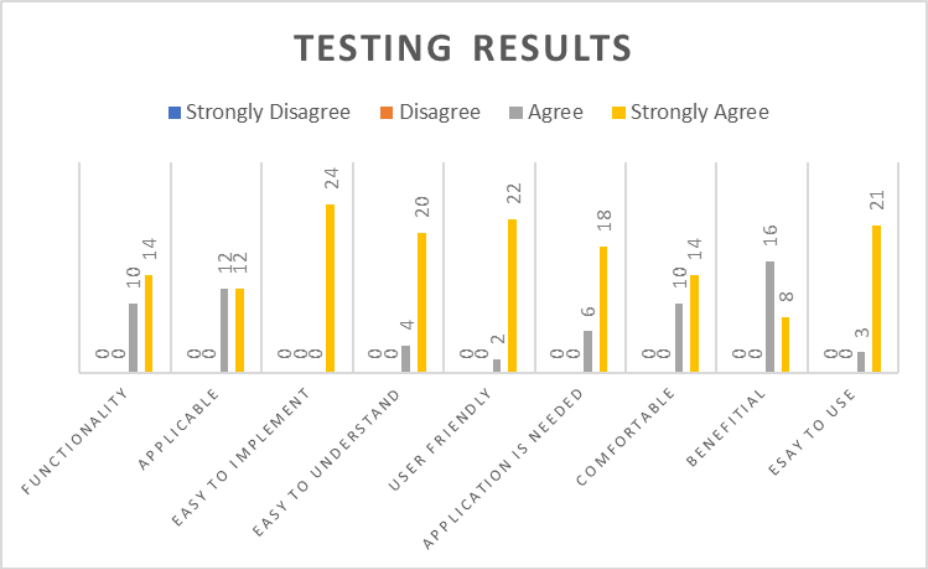


Figure 3. Testing results of the mobile app "EcoChildClo"

Table 2. The statements for user evaluation

	Keyword	Statement	Strongly Disagree	Disagree	Agree	Strongly Agree	Mean	STDEV
Functionality	Functionality	The application is equipped with all relevant data in pattern making.	1	2	3	4	3.58	0.50
	Applicable	The application performs its specific function without any delay.	1	2	3	4	3.50	0.51
	Easy to implement	The application is comfortable for navigating the functions.	1	2	3	4	4.00	0.00
	Easy to understand	Images that are used in the application support the content to be understood easily.	1	2	3	4	3.83	0.38
Usability	User friendly	Images that are used in the application make the content to be clear.	1	2	3	4	3.92	0.28
	Application is needed	The Application is necessary for pattern making.	1	2	3	4	3.75	0.44
	Comfortable	The text is clear and easy to be understood.	1	2	3	4	3.58	0.50
	Beneficial	The content of information in the application gives useful information.	1	2	3	4	3.33	0.48
	Easy to use	The application is simple to be used.	1	2	3	4	3.88	0.33

Finally, a comparative analysis was undertaken between the EcoChildClo mobile application and other clothing pattern-making mobile applications available in the market, as shown in Table 3. Most applications were found to consist of clothing photos with manual pattern-making templates, so there was no way to create and customise clothing in a specific size. Indeed, many mobile applications have been developed only for a particular goal, and clothes cannot be customised for individuals. Thus, when considering customisation and production, it would not be effective to choose only one basic application with some specific photos but without outcomes. It means that some

applications have drafts of children's clothing patterns while users cannot print out them on a particular scale or even customise the drafted pattern based on their measurements; therefore, they only can follow the drafts and make their patterns individually. Moreover, most mobile applications (refer to Table 3) provide no method to produce any output. Finally, no mobile application in the children's category considers custom children's designs. It should be noted that all the alternative applications can be run on Android platforms.

Table 3. Mobile applications to support pattern-making techniques in clothing industry

Mobile Applications	Custom	Category	Output	Pattern Draft	Description
Men's shirt pattern	-	men	-	-	consists of some clothing photos with ready manual pattern making
Clothes Sewing patterns	-	women	-	-	consists of some clothing photos with ready manual pattern making
Complete dress pattern	-	women	-	-	consists of some clothing photos with ready manual pattern making
Dress patterns measure cut sew	-	women	-	-	consists of some clothing photos with ready manual pattern making
Clothing pattern designs	-	women	-	-	consists of some clothing photos with ready manual pattern making
Circle Skirt Calculator	x	women	-	x	consists of some skirts photos with ready manual pattern making
Chalk; JSK Patrones	x	women	-	-	consists of some clothing photos with ready manual pattern making, it is in French and not free
Easy sewing pattern-making step by step	-	women	-	-	consists of some video tutorial
Clothing pattern design	-	women	-	x	consists of some clothing photos with ready manual pattern making
CloStyler	x	women	x	x	calculate parameters of basic clothing block, and it is not free
How to make a dress pattern	-	women children men	-	-	consists of some clothing photos with ready manual pattern making
Kids Clothes Sewing Patterns	-	children	-	-	consists of some clothing photos with ready manual pattern making
Easy kids' clothes pattern	-	children	-	-	consists of some clothing photos with ready manual pattern making
Pattern kids' clothes		children	-	-	consists of some clothing photos with ready manual pattern making
EcoChildClo	x	children	x	x	calculate parameters of basic clothing block and flat export patterns; it is free

5. Conclusion

The software implementation of mobile applications enables mobile technologies to create flat patterns for clothing. The EcoChildClo application was created for Android devices to customise the basic blocks of children's clothing. Sixty-six distinct varieties of children's clothes are accessible through this application; these designs were

created with four particular pieces: shirts/tops, pants, skirts, and dresses. This application is only accessible in English. Due to the issues with children's measurements and the lack of awareness of pattern drawing, users may be unable to design and understand custom children's clothing. Body measurements are used as input data for the calculation in this application. A user may specify a child's body measurements and the relevant measurements, such as seam allowance.

Moreover, users can complete and change the size fields to achieve the custom size approach. The primary goal of the research was to improve sustainability by reducing the amount of children's clothing disposed of as household waste due to ill-fitting. The fitting size of children's clothes offers a realistic strategy for reducing waste and consumption before any garment is produced. Hence, clothing waste may be decreased before production based on the children's body type. It means that this is not just focusing on their age and gender, but it also considers all significant related factors to fit clothes and prevent pre- and post-consumer clothing waste, either domestic production or mass production. Specifically, the research aimed to design and develop a type of mobile application for children's clothing that had not yet been investigated. Furthermore, the clothes in the mobile application are made to a standard size but may be altered to fit a child's body, allowing them to be worn for several years and therefore increasing clothing lifespan. It means the technology can help to revise the pattern-making techniques for different silhouettes or body shapes to consider intermediate sizes between the currently available sizes. This information might then be used to assist garment businesses to develop environmentally friendly alternatives when designing children's clothes. The originality of the current study is the employment of modular synthesis as a description of any step-by-step manufacturing process. The detailed description and method of pattern construction can be applied to any pattern draft approach with a mobile application. As previously mentioned, this application is compatible with Android operating system cellphones. Several characteristics must be considered when designing an Android-based mobile application, including the suitability of using illustrations and images with the material, the image appearance, and the application's adjustment on the smartphone display. For researchers and practitioners involved in developing mobile-based applications, the development of this application can serve as a model for future work. In the future, such applications might not run only on one operating system, such as Android; they could also function with other operating systems, the intention being that a broader range of organisations would adopt such applications.

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