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EVALUATION OF CHILDREN'S CLOTHING DESIGN EDUCATION USING THE MOBILE APP-BASED APPROACH

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Abstract. To propel the environmentally conscious movement forwards, recent technological developments must transition to sustainability in children's clothing production. Hence, this study aimed to investigate and evaluate a newly developed mobile application for clothing patternmaking, *EcoChildCLO* with a focus on the training aspect of customized children's clothing. Two techniques were applied for collecting data: first, interviews with six respondents involved in the children's clothing industry to verify the mobile application and, second, a focus group containing 19 fashion students to evaluate the mobile app's function. Workshop participants were invited to download the application, customize and print a pattern, and then explore their creativity in the children's clothing design process. This application had two main benefits: children's patterns could be made by those without previous knowledge; and making out-of-shape or waste children's clothing could be avoided, thus supporting sustainable pre-production systems. The outcomes reveal that the use of the mobile application developed effectively through the practical training system, while relevant knowledge became available to new users, whether or not they were experienced in children's pattern-making and clothing design. The results of the research show that basic pattern-making is not a major challenge in today's fashion education system; creativity is the most powerful factor in this domain. Over half of the students liked the children's clothing training via the mobile app. Through these findings, this work contributes to academic studies of pattern-cutting and children's apparel design instruction. The article concludes by discussing the future of children's clothing education and industry.

1.　Introduction

The clothes a child wears have a significant bearing on their health and growth (Zakaria, 2016). Clothes are indicators of growth and reveal the child's growth progression over time (Hennigs *et al*., 2012). Due to the lack of a standard size chart, sizing children's clothes has always been a concern, and clothing could arguably accommodate a larger population of consumers without causing fit issues. Hence, with the demand for children's products that offer various features - from traditional practicality and esthetics to flexibility, safety, and environmental protection - researchers and enterprises have introduced creativity into the sustainable design concepts of their products. Sustainable design is a natural, ecological, and expandable design approach

under the influence of fashion and clothing content, especially in regard to children's products (Zhang, 2018). The ability to use digital technology to improve sustainability is known as sustainable digitalization. Digitalization grants access to a unified network of untapped big data that could positively affect society and the natural world. The United Nations Sustainable Development Goals (SDGs) are a set of targets to be met by 2030 to guarantee a just, environmentally sustainable, and healthy society. The evolution of fashion and clothing design systems could create novel opportunities to strategically address existing problems. Digitalization introduces a new set of tools that must be properly balanced to ensure their intelligent application and environmentally friendly nature. SDGs can be attained through the innovative development of digital tools to generate, utilize, communicate, or source electronic data for organizational activities. Digital sustainability refers to efforts to create and use smart technologies to ensure long-term economic growth while considering and integrating the SDGs. This study proposes the use of a children's pattern-making mobile application for training purposes that was designed based on sustainable thinking, customization, and preventing children's clothing from going to waste. The app could be utilized to teach clothing design making to users who have never learned pattern-making but have the creativity to create new designs. Moreover, it could help to prevent out-of-shape and waste children's clothing from being made, as well as support sustainable pre-production systems due to the customized measurement options. This type of mobile app does not approach the process of producing patterns or even the structures of the patterns themselves; rather, it approaches a style of thinking that is both environmentally responsible and creatively original. Research into pattern-making techniques is vital to the successful operation of assembly lines in the garment industry. Pattern-making is one of the primary methods used in this age-old procedure to ensure finished goods are of the highest possible standard, so if the calculation and basic structure are not considered appropriate, the outcome is not practical and waste is created. Thus, pattern-making professionals need specific training and extensive practice to work in the textile manufacturing production chain. Beduschi and Italiano (2013) mentioned the serious lack of training at the academic and industry level. If the abilities of children's clothing pattern-makers do not match the industry's needs, the children's clothing industry and production are affected. The authors also stated that children's clothing waste occurs due to not only the outdated designs in the market but also the lack of suitable plans in the pre-production system and the need to improve the strategies applies. Moreover, fresh university graduates appear to lack creativity in relation to children's clothing, while the increase in children's clothing waste is another issue. Hence, training and education may help to resolve these issues. Sometimes creativity is lost because of limitations, but no attention is paid to this problem. Not having engaged in basic discussions of topics such as pattern-making in children's clothing design should not discourage students or anyone untrained in this field from actually designing in this field. The current research focuses mainly on using experts' perspectives to evaluate a mobile application for children's clothing design training to promote sustainability, as well as make it practical for junior learners. A sequential exploratory method, semi-structured interviews, and a focus group study were used to achieve research goals.

2. Literature Review

2.1. Digital Pattern-Making Design

Pattern-making transforms a designer's sketch into a functioning garment. Thus, the numerous forms and ways of pattern-making are addressed in this section, highlighting the need to define details using the various available techniques (Beduschi & Italiano, 2013). Beduschi and Italiano (2013) reported how the increased demand for the automatic grading of garment patterns was because of the expanding number and complexity of models and because the time available to make clothes was diminishing. Automatically preparing garment patterns based on body measurements from body scanning (Hu & Liao, 2023), as well as giving information about fabrics and how to make the garments, would help the apparel industry to stay flexible (Jalil & Hosseini, 2020). Improved software and pattern-making training would allow the main size patterns to be generated from drafts, making technology more efficient in the pattern-grading stage (Hu & Liao, 2023). Technology can become profitable during these processes by improving the automatic marker-making programs, preparing markers, and correcting them. As the results obtained by Ondogan and Erdogan (2006) indicate, technology will offer considerable advantages in terms of the speed with which it can fulfil orders that contain several pieces of varying sizes but that are only placed in limited quantities (Jalil & Shaharuddin, 2021). This could result in significant reductions in fabric costs. However, human labour is still needed to run this process, so the availability of this type of software would facilitate the entire garment-creation process (Jhanji, 2018).

Lectra, Gemini, Gerber Technology, and Optitex are only a few of the many types of garment pattern software utilized in the fashion industry. Compared to the time-consuming and labour-intensive process of creating garment patterns on paper from scratch, such programs are among the most convenient and efficient options available (Naznin et al., 2020), making it far simpler and quicker to create clothing designs (Jalil & Shanat, 2022; Ondogan & Erdogan, 2006). The goal of intelligent pattern-making is to develop patterns that precisely fit the dimensions and proportions of individuals, based on data provided by designers (Jalil et al., 2022). Patterns of any category and body type can be autogenerated. However, conventional manual pattern-making requires experienced pattern-makers. Consequently, numerous researchers have investigated intelligent pattern formation (Liu et al., 2019). Artificial intelligence pattern-making can replace the need for experienced pattern-makers, but a large number of experiments and patterns are required to populate a database. Traditional and intelligent pattern-making differ in terms of speed and precision, as well as the experience required. Consequently, intelligent pattern-making technology requires intelligence to build tailored patterns and generate pattern-making standards for various body types (Sun & Sun, 2021).

2.2. Technology in Childrenswear Design

Technology for children's clothes design can infuse practical work with design thought (Shaharuddin & Jalil, 2021). Fashion designers can now utilize their full professional potential with the help of computers, as well as innovative fashion design ideas and concepts. Computer technology, whether design or programming, can be used to enhance the design scheme of children's apparel as part of this process (Allakulov *et al.*, 2022). The process offers designers more options in terms of how garments will look, which increases efficiency and creativity. Patterning, marking, and grading garment

samples can be undertaken more precisely and quickly with modern computing technology. Fashion manufacturing may save both money and time by utilizing technological advancements (Hu & Liao, 2023; Jalil *et al*., 2022). Traditional clothing design can often be constrained in terms of garment materials and design concepts, resulting in inadequate clothing design. This can be resolved by technology. Interactive means can be utilized by fashion designers to invent clothing fabrics, shapes, and colours. With a burst of inspiration from a designer, imagination and originality can be increased. In addition, children's clothing design technology can give users differentiated and customized children's apparel (Jalil et al., 2022). This type of design can ensure that apparel is both functional and artistic (Hu & Liao, 2023).

In general, the development of children's clothing design technology should focus on innovative applications, with clothing design as the aim. Employing technology can substantially assist in the creation and growth of the current clothes design system (Jingyu *et al*., 2021). Additionally, garment manufacturers should conduct technical research based on children's various stages of growth. Overall, designers of children's apparel must improve their understanding and implementation of digital information technology. Hu and Liao (2023) argued that garment design should merge virtual design and actual necessity using digital technologies. Using an organic combination of intuition and reason, fashion designers must create apparel designs that are more aligned with genuine necessities (Jalil & Shanat, 2022). Distributing new technologies could provide the necessary technical and dynamic support for the long-term growth of apparel design (Hu & Liao, 2023). Being influenced by the development stage of the associated technology, contemporary garment designers must perform several duties. On the one hand, fashion designers must learn about design tools and design patterns systematically. On the other hand, they must also transform relevant technology into design-supporting tools. Only through extensive research and constant innovation can garment designers achieve the desired impact (Hu & Liao, 2023).

2.3. Children's Clothing Design Education

Barnett (2005) stated that children must be educated for a "changing world." Since fashion industry trends come and go so rapidly, it is impossible to say with certainty what skills and knowledge students will need to ensure their employability upon graduation (Barnett, 2005). Throughout their careers, designers must be flexible and open to new ideas and techniques (Jalil & Shaharuddin, 2020). To improve student performance and well-being in higher education, tutors must concentrate on preparing students for an uncertain future by assisting them in becoming disciplined professionals. Therefore, it is increasingly vital for students to learn the whys of their professions so that they can apply their knowledge in various circumstances (Al Liati & Al-Dabagh, 2021). To become pattern-makers, students must comprehend the hows and whys of pattern-building, whether manual or digital. The important point is having a standard pattern (Jalil & Shanat, 2022). Tinto (2006) argued that institutions must become involved and provide students with professional assistance. The majority of training aims are to impart new knowledge and skills to students. Self-learning is insufficient and ineffective for training; most professors want students to study related areas separately, such as children's clothing for fashion design majors (Suryani *et al*., 2018).

As part of the training system, Hu and Liao (2023) considered that students must gain an understanding of children's clothing structure and clothes drawing. Using technology in the classroom promotes the growth of the relevant majors and enhances the

teaching quality of majors in children's clothes design (Suryani *et al*., 2018). The problem noted by Kato et al. (2019) was that pattern designers without collection brand experience create garment designs lacking in general and complex lines, thus reducing the breadth of expression in pattern design evident in the work of experienced designers. Therefore, it is difficult to use a crude image to design a pattern that is accurate to the original brand's apparel, and skilled pattern-makers are more likely to be able to simply draw the patterns (Irmayanti & Hadi, 2018). In terms of talent training for children's apparel design, most classes offered were electives that encouraged people to develop knowledge through business practice (Naznin *et al*., 2020). This means most fashion designers become accustomed to designing children's clothing from the standpoint of designing adult clothing, but the fundamental patterns for children's clothing may be neglected (Jingyu *et al.,* 2021). The use of appropriate learning media can influence the accomplishment of learning goals and create interactive environments that are favourable to learning, provided that students are engaged in the learning activities (Ampera, 2017).

According to Ampera (2017), the usage of appropriate and varied educational media can help learners to overcome their passive attitudes. In this situation, educational media is utilized to stimulate interest in learning by allowing a direct connection between students and their surroundings, as well as permitting students to study based on their talents and interests. Pattern-making is a fundamental lesson in how to generate patterns correctly, so if students have already grasped basic pattern-making, changing other clothing patterns will be relatively simple (Jalil & Hosseini, 2020). On the other hand, if students have not learned about pattern-making, they cannot make their designs, unless they use automatic pattern-making systems (Hu & Liao, 2023). Therefore, the learning media used must attract students' attention effectively so that they can use and apply their creativity (Ampera, 2017). Based on the points described above, this study aimed to investigate and evaluate using a children's pattern application for training, which was developed by the author (Jalil *et al.,* 2022). The researcher distributed the app among third-year fashion students who had neither learned nor knew about children's pattern-making but had learned basic women's pattern drafting in their first year. The participants were asked to use the mobile app to choose a basic design - either pants, top, skirt, or dress - after which they needed to customize the measurements for that specific design and print the pattern. They could then manipulate the printed pattern based on their creativity and design children's clothing with a new look. Creativity may be lost because of certain limitations, and no attention is paid to the lack of basic discussions on topics such as pattern-making in children's clothing design. However, this should not discourage students or anyone with no training in this field from designing in this field.

3.   Methodology

Different data types were necessary because of the project goals and the many research topics. In this study, a workplace was developed to evaluate and investigate the use of the mobile application (Jalil *et al*., 2022) shown in Figure 1 by designers (senior and junior) in terms of their ability to make pattern drafting. The aim was to develop a strategy for sustainable design in the children's clothing market. Meanwhile, a focus study group approach was adopted to apply the pattern-making purpose and its function.

3.1. First Phase – Interviews

Kennedy and Vargus (2001) suggested that information obtained from in-depth interviews can support and enhance data. Many modes are also helpful when requiring measurements from a specific group and population for a research task. As mentioned previously, factors influencing clothing designers' viewpoints on the use of mobile applications, especially in garment design, were initially retrieved from databases including Web of Science, EI, ASCE, and Science Direct. Six people involved in the fashion design, clothing design, and production of children's clothing were then invited to semi-structured interviews to complement the exhaustive research into these factors. To improve the findings, the researcher conducted semi-structured follow-up interviews with people with over five years of industry experience in children's clothing design and production. Only six designers were interviewed (see Table 1), due to the lack of expertise in children's clothing and interest in digital and sustainable methods. They ranged in age from 36 to 54. The researcher believed that such people would have more knowledge about using applications and digital technology to improve the clothing industry.

The interview questions comprised three principal subjects. (1) The first section dealt with the informants' opinions of, overall comments about, attitudes to, and experiences of using mobile applications in sustainable clothing design. (2) The second section addressed their perceptions of visual stimulus functioning and several other items. The rating criteria were derived from research by Choi (2012). Several factors were studied to produce efficient and appropriate evaluation criteria. Typography, visual hierarchy, grid-based layout, alignment, colours, legibility, buttons, intuitiveness, simplicity, navigation, content, appeal, and consistency were some aspects that fell under this category. (3) In the last section, each respondent's age, occupation, location of their employer, and years of work experience with their current organization were obtained for demographic information purposes. Audio recordings of the 30-minute interviews were made with the interviewees' permission. The researcher used a semi-structured interview approach. The responses were evaluated and included in the final report. Periodically, the researcher checked the interview transcripts to guarantee the consistency and validity of the analysis. Before data collection, two junior designers who did not satisfy the research criteria participated in a pilot study. This pilot testing enabled the researcher to revise certain interview questions and methodological aspects. The data collected during the pilot interviews were excluded from this study. After the interviews, feedback was applied to improve the image and functionality of the application using JavaScript Programming (Jalil *et al.,* 2022).

3.2. Second Phase – Focus Study/Workshop

The researcher applied the experimental approach, whereby the research tools were applied to the sample before proposing the application. The aim was to determine the efficacy of digital children's pattern-making for students via a mobile application. The study population refers to 19 fashion students from the class of 2022 at Universiti Malaysia Sarawak, all of whom had taken the Pattern-Making and Fashion Draping course. The workshop comprised two contact teaching hours and approximately four individual working hours. Nineteen participants took part in the training workshop and agreed to participate in this study. All the participants were undergraduates and aged 20 on average. They showed visually how they understood or would make a pattern by using a mobile application for cutting children's clothing. The students became acquainted with

adherent approaches that challenged the conventional pattern-cutting processes and fashion design instruction. In the next stage, the researcher invited the students to download the mobile application and use it to learn about experimental pattern-cutting and the students was requested to fill up a questionnaire to evaluate and give weight to the mobile app's functionality and visual appearance.

4.   Results

4.1 Findings of the In-depth Interviews

The author expected to obtain information about the sustainability potential of using a pattern-making mobile application in the production of children's clothes. The primary aim was to understand positive and negative perceptions of the EcoChildCLO mobile application. Table 1 shows the demographic profile of the interviewees. To generate the views of the informants, the author asked them to install the mobile application prototype and look at it before the interview sessions. Lasting between 20 and 30 minutes, the interviews were audio-recorded and transcribed. By open coding and microanalysis, the author analyzed the interview data. The interview transcripts were read in several ways, the coded data were labelled, and news reports were made. An initial categorization was created, after which the author examined the coded data, discussed interpretative possibilities, and agreed on the organization and display of the data. By analyzing app descriptions, users can gain insights into the content of an app, which may determine whether they will download it. This study involved "usability and performance testing" and it was suitable for assessment. Testing an application's usability can determine how well it performs and serves its intended purpose for a certain demographic. The terms "usability" or "user testing" refer to how well an app performs and whether it accomplishes the goal for which it was designed. App usability is typically evaluated via several aspects, including user ratings of flexibility, operability, understandability, learnability, efficiency, contentment, attractiveness, consistency, and mistake rates. Researchers and clinicians whose work focuses on a particular group may find it helpful to conduct usability testing that is tailored specifically to that community. In this study, the participants were asked for their views and opinions regarding the usability and functionality of the new application.

Table 1. Demographic information interviewees

	Age	Career	Expertise	Experience	Sex
E1	56	Owner	childrenswear production	25 years	Female
D1	38	Designer	clothing design (children's wear)	9 years	Female
L1	35	Lecturer	clothing design (children's wear)	11 years	Male
E2	45	Owner	children wear production	15 years	Male
D2	32	Designer	fashion design (children's wear)	7 years	Female
L2	48	Lecturer	clothing design (children's wear)	20 years	Female

As mentioned previously, usability comprises positive and negative comments about user interface features and operations, possibly in addition to reports of problems experienced while operating a mobile application. D1 stated, "*In my opinion, the producers and manufacturers of clothing children's products are also alien to this concept and have not been advised. I think they would welcome it if it became a trend to use in the industry but [the developer] needs to add customization features.*" D2 believed that "…*educated*

students, manufacturers, and customers were more willing to use such these applications when they know the value of training knowledge without putting [in] too much time and effort." Table 2 shows the informants' responses to the features of the EcoChildCLO mobile application. Regarding the experience of and engagement in digital pattern-making design, E1 said, *"I do not have any experience [of] using mobile application output in my design process and production; perhaps it is risky to design. I am not very sure about the outcome."* Nevertheless, all the informants suggested that pattern-making and drafting children's clothing design would be practical with the use of mobile applications, and industries and entrepreneurs are becoming increasingly interested in using such systems to save money, time, and work. In regard to the lack of specific children's pattern-making courses at the College and even university level, E2 stated that *"sometimes, we need to hire someone in pattern-making just in children's clothing, but it is very hard to find the person with this knowledge, so we need to hire some juniors and train them and use their knowledge later."* L1 emphasized that "…*it must be cultured, and the people get to know. Besides, we should explain to people the mobile app's benefits. This concept and promotion in the community is a big step in the children's clothing industry."*

D2 had a positive experience with a mobile application for making clothing, and customized clothing design is always a factor in her career. L2 believed that children's clothes could be designed according to a consistent trend because clothing styles for children are closely linked to current trends in fashion, so these aspects could be connected to ensure they are up-to-date. The information obtained from the six respondents showed that the concept and functionality of the ECOchildClo application were acceptable. However, the UX design needed improving; some suggested changes in the revised version were the addition of, firstly, the ability to print A4 pdfs using a normal printer and, second, customization features. Therefore, whether designers or students, most people were interested in using this application for clothing production.

L1 presented her excellent reaction: *"All [the] designs are great. It is very effective because of the children's growth and some issues during consumption may be raised, so parents can make their measurements individual and [this may not be] just in making clothes, [it may] even [be used] for purchasing clothing later."* Asked about training university students in children's clothing making with this application, L2 stated, *"Well, it is extremely interesting in my opinion, since students rarely know how much they had learned until we ask them to take the time out to reflect on what they have achieved. Until then, they don't realize how much they have learned. This kind of introspection and reflection plays a significant role in the practical learning process. So if you ask them to use this application and compile [this] with what they have learned from pattern-making course till now, it is more effective … than just letting them not use pattern drafting for kids due to [a] lack of teaching credit."*

After reviewing the interviewees' comments and suggestions, most were implemented by the programming team, except for those not in the scope of this study (these are discussed later as recommendations for future study). Overall, based on the findings, the respondents offered positive feedback and stated that the app was a good idea, especially in the children's clothing industry and market. Their greatest concern was the customization design that could be used to make designs, which is a feature that might be included in future studies. Some potential improvements which are listed and bolded in Table 2 have been implemented and the mobile app layout is illustrated in Figure 1.

Table 2. Informants' responses

No.		Drawbacks/ Benefits	Suggestions
E1	Owner	(-) not the readable colour scheme (-) not visible buttons (+) innovative concept for children's patterns. (-) printing out the pattern on a large scale is easier, and the industry may buy the plotter. (+) simple presentation (+) easy to use. (+) there is no sign-up required.	. the concept is very attractive and modern. If the payment of the app becomes affordable, demand will increase. **. changing the colour palette may help to be more visible.** **. it can be used for educational purposes.**
D1	Designer	(-) maybe a bit complicated for people who have not seen the drafting app for the first look. (-) it is not easy to return. (+) smooth operation (+) all combinations and designs look good.	. it is a good idea to commercialize and promote among the clothing industry if add customization design features.
L1	Lecturer	(-) hard to convince people, especially nonacademic, to use this app for drafting. (+) great ideas of pattern making for children's clothes, children's clothing pattern making is rare. (+) easy to understand. (+) try to make one piece with this app.	. add customization design features, maybe they want to design their style. **. promotion such as these applications in university once student graduate they can apply at the industry level.**
E2	Entrepreneur	(-) it is not easy to print out a plot if you live in a small city. (+) the design concept is excellent. (+) interesting operation (+) helpful and very useful app	**. using a set of clothing more casual appearance or a set of small pdfs, may help to convince the clothing industry to utilise it.**
D2	Designer	(-) for those who have no knowledge pattern drafting is interesting and applicable, but the pattern maker needs to do more design or customization. (+) love the design so cute. (+) versatility is good. (+) styles look very lovely but not enough.	**. simplify the design.** . creative, but needs customization if this app is going to be promoted for industry and on a large scale.
L2	Lecturer	(-) helpful for all, not the specific region. I think this app would be more helpful if it set measurements based on each country and region. (-) it is just in English. (+) practical (convenient for children's drafting). (+) great investment for not wasting time and reaching to design immediately. (+) consistent processes. (+) there is no sign-up required.	. trends need to be supported by the app, new looks are coming soon every season, even for kids. **. in academic level, at least in university and college due to there being no specific course for children's pattern drafting, it would be suggested to promote and teach students about this application.**

Figure 1. Developed mobile app layout (Jalil *et al.,* 2022)

4.2. Findings of the Focus Group

As shown in Figure 2, the discussion started after the participants had been allowed to download the mobile application, talk with the researcher, and receive answers to questions. Having understood what to do, the students were asked to form groups of three. First, they were asked to state what they liked/disliked or would add/change, especially in terms of usability features, referring to the EcoChildCLO mobile app from an educated young woman's standpoint. Most students (94.7%) emphasized that they had never had the chance to use clothing-related mobile applications, so this was their first experience; however, they were satisfied with the navigation and figuring out how the app worked. One student stated, "*I constantly play with my phone, but I never thought it might satisfy a need to create pattern-designing without spending money and costs, especially on children's apparel. This is wonderful for pupils, including my mum without knowledge of pattern-making, who always wanted to make clothing for my youngest sister. Though I'd prefer additional sleeve and collar options, these outfits are smartly designed. I wish it was iOS compatible.*"

Most participants (89.47%) showed positive reactions to using and communicating with the mobile app, with only two students confused about customizing measurements and how to do this. The researcher explained this to these two students, who said a demo showing how to use the mobile application would be very helpful. Overall, they reacted positively to the app usage and understood the features after 15 minutes. After that, they confirmed their customized children's clothing patterns before creating and saving their pdfs. The researcher gave them a two-hour break, after which they were given the printed patterns so they could start their task. Students commented on how strict they thought the lecturers initially were about making patterns for womenswear: if their pattern was a few millimetres off, it would be marked incorrect.

Figure 2. Focus group activities.

Moreover, it would be even riskier if they wanted to use their knowledge to make patterns for children, so they had not learned about this and were therefore satisfied to have their ready-made pattern. They could observe the clear difference those few millimetres made to the finished garment by the new application. As one student remarked, "*You find the mistakes in your design in your garment. Now, once the pattern is ready based on the children's body type and measurement, we are more confident to make the clothing even if we did not know [how to] before.*" This shows that the students had developed the ability to recognize the impact of one subject on another, thus improving their ability to articulate and comprehend the process followed by a fashion designer. The feedback indicated that the students had positive experiences with the

training environment and resources, as well as the mobile app and the printed designs provided. The participants expressed how they were learning something new from this experience. Because of this, the students had such positive attitudes and participated quite actively in the training. Successful training means participants are motivated to learn more and improve their skills because they enjoy the learning experience and find it rewarding. On the other hand, if participants are dissatisfied, they will not be motivated to continue with the training. In other words, the success of a training process is inextricably linked to the level of interest, attention, and motivation exhibited by the participants during the training activities. When people react positively to their learning environment, they will learn more effectively. The results from this study illustrate that the evaluation of the usability and design features of the EcoChildCLO mobile application indicated that the app was considered easy to use, functional, and had good design features. Hence, after downloading and understanding the application, the researcher found that students perceived the EcoChildCLO mobile app as easy to use and understand, as well as having a user-friendly design, a good appearance, and good colour features. This indicates that fashion students could easily communicate with the pattern-making mobile app, even if they have no previous subject knowledge. Therefore, the acceptance and function of the EcoChildCLO produced positive reactions among the participants. In conclusion, the researcher feels justified in claiming that the project was successful due to the increased intentionality in every aspect, not just the application evaluation.

The tasks would support students as they make children's clothing. One student mentioned that exam-condition projects were a true test of ability, whereby they learned and then applied this knowledge. Doing tasks, they have never been taught might initially seem too difficult for students who have not attended this workshop, but this would not be the case because the participants found it easy to navigate the mobile application and understand the functionality. Moreover, whereas they claimed to be scared to design for children because of the pattern-making, once the researcher had given them their printed patterns, they started to manipulate the patterns and become more creative. As they already had printed patterns, they only needed to manipulate the patterns to create new ideas. Some students trusted the patterns and were satisfied with the given design and did not perform manipulation, but the researcher asked them to add their creativity as this was the goal of the study. However, if they created an overly complex design, they may have been able to analyze the design and determine that it needed to be simplified to better suit their specific skills. The significance of setting high standards for learners cannot be overstated. The objective is to provide assessments that are not only difficult for students but also engage them, allowing them to explore many correct solutions, learn from and remedy their errors promptly, and provide timely and dialogic feedback. All students were engaged in creating identical clothing items, specifically focusing on pattern making and sewing of a specific girl's dress and boy's pant, to compare their acquired expertise.

Moreover, The evaluation of the mobile app involved administering a questionnaire to students during the workshop. All students were given questionnaires to gather user responses and ratings regarding the application. The objective was to collect user responses and ratings for evaluating the application, utilizing statements displayed in Figure 3. These statements were borrowed from the study conducted by Sutopo et al. (2019) and were designed to measure users' perceptions using a four-point Likert scale, which allowed for improved calculation of means and standard deviations. Participants had the option to indicate their attitudes by selecting one of four options: "strongly

disagree," "disagree," "agree," or "strongly agree." Each response option was assigned a corresponding value of 1, 2, 3, or 4, respectively.
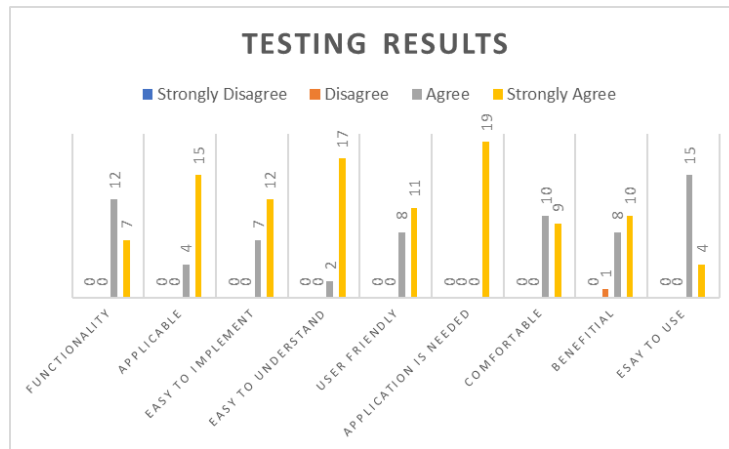

Figure 3. Testing results of the mobile app "EcoChildClo" among fashion students

Based on the student's feedback (Table 3), it can be inferred that the application demonstrated favourable characteristics. The results indicated that the application was deemed necessary (mean = 4), easy to comprehend (mean = 3.89), and practical (mean = 3.79). These findings suggest that the application has the potential to assist students interested in designing and customizing children's clothing in the future. Additionally, the respondents' average score of 3.21 out of 4 for "Easy to Use" highlights the need for children's clothing applications to support real-world usage, potentially by providing printed patterns and addressing any challenges encountered by users.

Table 3. The statements for students' 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	3.37	0.49
	Applicable	The application performs its specific function without any delay.	1	2	3	4	3.79	0.42
	Easy to implement	The application is comfortable for navigating the functions.	1	2	3	4	3.63	0.50
	Easy to understand	Images that are used in the application support the content to be understood easily.	1	2	3	4	3.89	0.31
Usability	User friendly	Images that are used in the application make the content to be clear.	1	2	3	4	3.58	0.50
	Application is needed	The Application is necessary for pattern making.	1	2	3	4	4.00	0.00
	Comfortable	The text is clear and easy to be understood.	1	2	3	4	3.47	0.51
	Beneficial	The content of information in the application gives useful information.	1	2	3	4	3.42	0.61
	Easy to use	The application is simple to be used and applied.	1	2	3	4	3.21	0.42

5. Discussion

Overall, the findings showed that designers and manufacturers could be interested in producing children's clothing using the EcoChildCLO mobile application, either in industry or at university, if certain features are added. The academicians were more excited about children's pattern drafting and clothing design in the children's market from the perspective of fresh ideas. They stated that the lack of knowledge in this domain prevents students from working in the children's clothing market after graduating. Raising awareness about how the use of such applications can save time, money and labour may help industrial players and universities to utilize this application in their design processes, as previous researchers have noted (Sun & Sun, 2021). Therefore, the practical purpose of children's clothing should be developed to promote highly sustainable clothing design in terms of pre-production and post-production. Moreover, the participants stated that a video demonstration for users of this mobile application could be helpful for those without pattern-making knowledge, even for mothers with no university education but who wish to make dresses for their children. The data analysis results indicated that the drafted patterns in the EcoChildCLO mobile app fell into the "good" category, which means the app could feasibly be used as a medium of learning at the university level or even by users at home.

The workshop enabled the researcher to recognize instances when frustration hindered the growth of the creative process, as well as the generation of solutions to such difficulties. In addition, the method's applicability could extend beyond the clothing industry into other creative fields. It is suggested that public involvement be extended to include the government, entrepreneurs, and marketers, which shows how digital and customized drafted pattern-making for children's clothes can help to reduce adverse environmental effects and develop features of the economy. Training and organizing workshops should educate junior designers about sustainable clothing programs, especially in regard to children's clothing products. The study shows that designers, and even clothing lecturers wishing to design with drafted patterns, should ensure that children's clothes are designed according to an acceptable fit and style. All the interviewees involved in the children's clothing domain believed that commercializing and promoting the EcoChildCLO mobile app in the industry would be appropriate if customization design features were added. They stated that the application might be used in industry and even by home users. Hence, it can be concluded that the initial concept of this mobile application could be a significant step in changing the children's clothing design process and creating more scope for creativity and innovation. Based on the workshop experience, the researcher suggests that the children's clothing patterns created by the EcoChildCLO mobile application could be a valuable introduction to pattern-cutting for fashion design students.

The method seeks to question the widely held belief in fashion studies that pattern-cutting, particularly in the realm of children's apparel, necessitates a difficult learning practice. Instead, this app presents pattern-cutting as a relatable and unexpected exercise, with ample potential for the creative and personal expression of practitioners. The user only needs to apply the correct measurement and take a printed pattern, after which the pattern is ready for more creativity or immediate use as a normal design. This characteristic of openness might stimulate and broaden the scope of pattern-cutting. Some forms found in experimental pieces might produce further works, allowing participants to build their repertoires of processes and patterns as part of the creation of their learning

journeys in the field. Learners should navigate the process by constantly questioning and making problem-solving judgments rather than merely following instructions with no scope for experimentation. Similar to other research, this study suffers from certain limitations. First, the variety of choices for clothing designs is limited, so the author used fifty-five common types of children's clothes. Moreover, only six people could be interviewed because of the lack of expertise in children's clothing and interest in digital and sustainable methods. In addition, all nineteen workshop participants were from the University of Malaysia Sarawak, which is a significant constraint in terms of research sampling. Additionally, the short workshop duration must be considered. Therefore, additional research is required to validate and verify the findings, especially among home users of this application.

6.   Conclusion

People's levels of knowledge and quality of life are continually improving as a result of the rapid development of society and the economy. The old clothing design industry has transitioned into a new era marked by the rise of information technology due to ongoing digital and network technology developments. The advent of digital technology in the design process has paved the way for the industrial customization of children's apparel design. This has been made possible by the previous foundations. The current paper offers an in-depth analysis of a distributed mobile application and its technology dedicated to children's clothing pattern-making and clothing design. This study investigated and evaluated expert and non-expert feedback on drafted patterns for children's clothing taken from the EcoChildCLO mobile application, although the study is affected by sampling limitations. The findings show that digitalization and the functionality to create customized patterns without in-depth knowledge might significantly affect the intentions of users to be involved and explore their creativity. Whether academicians or non-academicians, all users can make environmentally friendly choices to reduce clothing waste during the design process for children's apparel, thus helping to protect the environment. The findings of this study are significant because they demonstrate that new tools within a sustainable approach to clothing production can be easy to accept, understand, and use. Meanwhile, it would not be overly difficult to utilize time, money, and labour to produce stylish clothes for the children's clothing market. Fresh graduates are welcome to become involved in this domain, while interested parents could make clothing for their children, even if their lack of pattern-drafting knowledge meant they were unable to do so previously. However, more evaluation is suggested in future research. Using a larger sample population would produce a more effective survey. Overall, the findings form a critical component of the literature on sustainable children's design.

References

Al Liati, A., Al-Dabagh, M. (2021). Measuring the Effectiveness of a Proposed Educational Program in Teaching Pattern-Making of Children's Clothing to Severely Hearing-Impaired Students Using E-Learning. *Open Journal of Social Sciences, 9*(12), 18-41.

Allakulov, B., Sh, T. A., & Bazarbayeva, G. (2022). Analysis of Fashion Trends of the Range Children's Clothing. Periodica Journal of Modern Philosophy, *Social Sciences and Humanities, 4*(1), 53-56.

Ampera, D. (2017). *Adobe flash CS6-based interactive multimedia development for clothing pattern making.* Paper presented at the International Conference on Technology and Vocational Teachers (ICTVT 2017).

Barnett, R. (2005). *Reshaping the university: new relationships between research*, scholarship and teaching: McGraw-Hill Education (UK).

Beduschi, D.P., Italiano, I.C. (2013). Guidelines for Pattern-Making Teaching and for Didactic Materials. *International Journal of Arts and Commerce, 2*(9), 146-156.

Choi, J. (2012). Creating an evaluation system for a mobile application design to enhance usability and aesthetics. Graduate Theses and Dissertations.

Hennigs, N., Wiedmann, K. P., Klarmann, C., Strehlau, S., Godey, B., Pederzoli, D., & Donvito, R. (2012). What is the value of luxury? *A cross-cultural consumer perspective. Psychology & Marketing, 29*(12), 1018-1034.

Hu, L., Liao, K. (2023). Teaching Method of Children's Clothing Appearance Design based on Distributed, *Computer-Aided Design & Applications, 20*(4), 167-176.

Irmayanti, I., Hadi, S. (2018). *The Contribution of Pattern Making Knowledge and Sewing Skill to the Outcome of Women's Blazer Making.* Paper presented at the International Conference on Indonesian Technical Vocational Education and Association (APTEKINDO 2018).

Jalil, M.H., Hosseini, S.K. (2020). Quest for the Fashion Market: Zero-Waste Skirt Design as a Solution Toward Sustainable Pattern Making. *The Chitrolekha Journal on Art and Design, 4*(2), 1-11.

Jalil, M.H., & Shaharuddin, S.S. (2020). Fashion Designer Behavior Toward Eco-Fashion Design. *Journal of Visual Art and Design, 12*(1), 1-24.

Jalil, M.H., & Shaharuddin, S.S. (2021). Sustainable Children's wear with Zero-Waste Grading Design in the Clothing Industry. *NVEO-Natural Volatiles & Essential Oils Journal, 1*(1), 11926-11936.

Jalil, M.H., Shanat, M. (2022). Developing A Sustainable Childrenswear Sizing System: Body Size, Silhouette Shape And Clothing Key Dimensions. *New Design Ideas, 6*(2), 229-242.

Jalil, M.H., Shanat, M., & Moghadasi, K. (2022). EcochildCLO: A Mobile Application for Customisation of Children's Clothing Toward Sustainability. *New Design Ideas, 6*(3), 285-297.

Jhanji, Y. (2018). *Computer-Aided design—garment designing and patternmaking Automation in garment manufacturing,* Automation in garment manufacturing. (pp. 253-290): Elsevier. Woodhead Publishing.

Jingyu, D., Hongyu, D., Jianxing, W., & Xuanzi, W. (2021). Children's clothing virtual simulation immersive design and show based on machine learning. *Mobile Information Systems, 1*(1), 1-9.

Kato, N., Osone, H., Oomori, K., Ooi, C.W., & Ochiai, Y. (2019). *Gans-based clothes design: Pattern maker is all you need to design clothing.* Paper presented at the Proceedings of the 10th Augmented Human International Conference 2019.

Kennedy, J.M., Vargus, B. (2001). Challenges in survey research and their implications for philanthropic studies research. *Nonprofit and Voluntary Sector Quarterly, 30*(3), 483-494.

Liu, K., Zhu, C., Tao, X., Bruniaux, P., & Zeng, X. (2019). Parametric design of garment pattern based on body dimensions. *International Journal of Industrial Ergonomics, 72*(1), 212-221.

Naznin, K. N., Tabraz, M., & Sultana, S. (2020). Process & Effective Methods of Pattern Making for the RMG (Ready-made Garment) Sector. *Journal of Research & Method in Education, 7*(1), 46-48.

Ondogan, Z., Erdogan, M. (2006). The comparison of the manual and CAD systems for pattern making, grading and marker making processes. *Fibres and textiles in Eastern Europe, 14*(1), 62.

Shaharuddin, S.S., Jalil, M.H. (2021). Parents' Determinants Buying Intent on Environmentally Friendly Children's Clothing. *International Journal of Business and Society, 22*(3), 1623-1638.

Sun, Q., Sun, X. (2021). Research on the Technology of Mass Customization of Clothing. *International Journal of Modeling and Optimization, 11*(3), 86-93.

Suryani, H., Imayanti, I., & Yahya, M. (2018). *The Effectiveness of Clothing Pattern Making Training with CAD-based System on Fashion Students.* Paper presented at the International Conference on Indonesian Technical Vocational Education and Association (APTEKINDO 2018).

Sutopo, A. H. (2003). Multimedia Interaktif Dengan Flash. *Yogyakarta: Graha Ilmu, 1*(1), 32-48.

Tinto, V. (2006). Research and practice of student retention: What next? Journal of college student retention: Research, *Theory & Practice, 8*(1), 1-19.

Zakaria, N. (2016). *Clothing for children and teenagers: anthropometry, sizing and fit*, Woodhead Publishing.

Zhang, L. (2018). *Study on Children Product Design And Development Based on Fashion Consumption.* Paper presented at the 2017 7th International Conference on Social science and Education Research (SSER2017).