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Development of a Mobile Application to Study Sewing Techniques for Manufacturing Fur and Leather Clothes

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Abstract
The global COVID-19 crisis has led to the international isolation of educational institutions, which have had to adapt to changing ways of presenting the information. Mobile applications are the future of the education sector, leading toward its development. The study aims to develop a mobile application to support learning the peculiarities of leather and fur garment manufacturing sewing techniques. The mobile app "TechLab" was developed by using MIT App Inventor. The article proves the effectiveness of its use in the educational space based on social surveys among teachers and students at different levels of education.

Keywords
mobile application, leather, fur, sewing techniques, technology sequence.

1. Introduction

The garment industry characterizes by a reasonably high level of sewing techniques of garment manufacturing and extensive specialized enterprises. The technology for processing garment elements is very mobile and changes with the advent of new materials and a unique variety of equipment. So, the latest achievements of science, technologies, and applied art should be used when designing clothes. The selected design solutions, corresponding to the creation of high aesthetic properties and requirements, can be satisfied by constantly improving the sewing techniques of garment manufacturing.

At the same time, an increase in the efficiency of garment manufacturing processes can be achieved through the use of progressive manufacturing methods. Thus, the garment industry needs highly qualified specialists trained in higher educational institutions.

The global COVID-19 crisis has led to the international isolation of educational institutions, which had to adapt to changes with the changing nature of information and rapid developments in Information and Communication Technologies. Transitioning to online learning is an opportunity to modernize the learning and teaching of subjects. Especially in the context of the rapid development of wireless communication technology, mobile learning has developed rapidly, making mobile learning applicable to all areas of life. These include primary education, higher education, and lifelong learning.

In recent years, smartphones have evolved from a fringe curiosity to an absolute necessity in today's world. Students tend to use their mobile phones for every purpose, including learning. With mobile apps, there are practically no restrictions and boundaries, and one can learn at any place and time, at their pace. The mobile application has many advantages in teaching students: it promotes faster assimilation of information, preparation for classes in the specialty, and is relevant in the professional and scientific field. In addition, the presence of the application on the device saves users the time spent opening the browser and finding the right site.

Thus, mobile applications are the future of the education sector, leading toward its development. Therefore, it is essential to study the development and formation of knowledge and skills of students and teachers with the help of mobile technologies in teaching and learning. In the lineup of apps, there are apps for every life situation: entertainment, financial transactions, practical tips for every day, education, and apps for professional development.

2. Analysis of Published Data and Stating the Problem

During the last years, the study of mobile applications in the different manufacturing fields has been an emerging trend in the scientific literature. Many scientists and teachers recognize the positive results of mobile learning [1,2].

The paper [1] analyzed the reviews and ratings of mobile learning apps. Word frequency, sentiment, and content analysis were performed on 2000 reviews of four highly rated, downloaded, and reviewed mobile learning apps on the Google Play store. The majority of the reviews had a positive sentiment. The article concludes with a discussion on the learners' experience using mobile learning apps, implications for practice, limitations, and future research directions.

The studies cover the possibilities of using mobile applications for learning or as a tool in the learning process [3, 4].

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Most of the research focuses on the overall impact of mobile learning on students in various fields, such as: learning foreign languages for children [3-4], adults [5, 6], and old adults [7], social sciences [8], game-based learning [9-10], programming languages [11-13], learning for children with Autism Spectrum Disorder [14], learning physics [15] and mathematics [16], professional development applications [17-20]. The authors of these works conclude that students participating in research usually express a positive attitude towards such teaching tools.

Clothing design is one of the most creative realms in the contemporary world. But it is a highly developed technological industry as well. Mobile applications simplify designing and manufacturing garments and improve communication channels for clothing companies. They could be a helpful tool for industry professionals and consumers. However, few scientific articles are devoted to developing mobile applications to support the garment industry, particularly in the sewing technique of garment manufacturing. Today's mobile applications available in the garment industry primarily focus on supporting the market for finished products in the fashion industry.

The paper [21] presents a study on mobile applications that support online commerce for clothing, focusing on the review of the mobile applications with features of the circular economy paradigm. This study proposes the analysis of an innovative taxonomy of mobile applications about the circular economy.

We found out that there are some mobile applications that students can use in the educational process in the field of apparel design. Applications for the calculation of different garment types patterns such as "CloStyler" [17], "SHOES Step-by-Step", "RDMK Step-byStep" [18], "N_ Underwear" [19] purposes to reduce the time wasted while constructing patterns and at the same time to increase their accuracy. The mobile applications are concerned with top wear garments and underwear. In these apps, users may choose a pattern drafting method and a garment type.

However, few scientific articles are devoted to developing mobile apps to support sewing techniques, particularly in choosing garment manufacturing methods.

The correct choice of the technology sequence for manufacturing product elements, considering the direction of fashion and the peculiarities of the processing, is essential for improving the quality of clothing.

The analysis of literature sources indicates the need for additional research and systematization of known data to introduce mobile technologies in the sewing technique of garment manufacturing. There is an urgent need to develop such mobile applications aimed at their use by students and specialists in the garment industry.

Therefore, the current research aims to develop a mobile application to support learning the peculiarities of sewing techniques of natural and artificial fur and leather garments manufacturing. To achieve this goal, we need to complete the following tasks: (1) to analyze the market of existing mobile applications for use in garment manufacturing; (2) to generate initial data for application development; (3) to develop a prototype of a mobile application; (4) to perform testing and evaluation of the developed application.

3. Methodology

The first step in any application development is market exploration. Thus, we performed a statistical analysis of the already existing apps. By keywords: "sewing course," "sewing lessons," "easy sewing," "sewing classes," "sewing guide," "tailor course," etc. formed the sample based on search results on the respective platforms of mobile applications.

The total number of applications that meet our requirements is over 150 mobile sewing applications placed on Google Play and App Store platforms. The features include modern ways of connecting parts of the clothes, sewing equipment, and advanced techniques for manufacturing clothes of various assortments with established and quality properties.

The authors have searched the mobile applications related to the sewing techniques of garment manufacturing according to the following criteria: (1) the availability of the garment manufacturing component; (2) the download and registration are free; (3) the existence of updates between 2017 and 2022; (4) the availability in English. We have selected 25 mobile apps with the most significant differences (Table 1).

Analysis shows that the number of mobile applications developed for the Android operating system exceeds that of mobile applications for iOS (Android – 85,2%, iOS – 14,8%).

According to the results of the review of mobile applications, they divide into three categories depending on the method of presenting information for studying: video tutorials (44 %), textual information supplemented by a photo (36 %), and photo images with examples of the sequence of garment manufacturing (20 %).

Most of the applications are devoted to learning hand stitches and machine seams (28%), other applications contain information on the sequence of manufacturing certain types of clothing (60%), and some are devoted to learning about the sewing machine work (12%). However, in apps with a technology sequence for manufacturing, there are no variants of methods for manufacturing main product elements, among which the student could choose for himself, considering his existing equipment. In addition, none of the mobile apps provides information on manufacturing products from such fashionable materials as natural and artificial leather and fur.

Therefore, the amount of information and the variety of ways to present it in the

Name	Description	User Ranking	Number of Downloads	Author	Language	Year
500 + dress patterns - measure-cut-sew	An app with videos tutorials with techniques and tips for beginners to make each piece of clothing step by step	1.8	more than 100000	Tulipa 7789	English, Spanish, Portuguese, French, Japanese, Indonesian, Hindu	2019
HOW TO CUT AND SEW	Using this app, one can learn the basics of hand sewing	–	more than 50000	Othmane androapp	English	2021
Dress patterns and easy sewing	There are a lot of videos in this app for free and accessible learning to cut and manufacture clothes	–	more than 5000	Rafaela Oneil	English	2019
Sewing Classes (Guide)	An app of sewing course for the beginner. Lessons on different sewing techniques, understanding basic sewing patterns and learning basic cutting skills	–	more than 50000	Art &Craft Studio	English	2021
Sewing Lessons	Using the video lessons in this app, one can learn to draw patterns on paper and fabric, measure patterns, and cut dresses or suits. Learn how to sew, embroider, and crochet	–	more than 10000	Natural Forest	English, Spanish, Portuguese, French, Japanese, Indonesian, Hindu	2020
Online sewing course	An app contains sewing lessons from scratch to make children's clothes of all ages – an easy sewing course with hand embroidery, cross stitch, ruffles, honeycombs, and macrame knots	2.7	more than 50000	Musica Clasica	English, Spanish, Portuguese, French, Japanese, Indonesian, Hindu	2020
Easy sewing learns to sew	An app places sewing and embroidery lessons by hand and machine for beginners	–	more than 100000	Persamientopositivo 222	English, Spanish, Portuguese, French, Japanese, Indonesian, Hindu	2020
Lessons learn sewing step by step	A step-by-step video tutorial app teaches the sewing techniques for beginners (both cut and manufacturing)	–	more than 10000	ANASTASIA SOCOLOV	English, Spanish, Portuguese, French, Japanese, Indonesian, Hindu	2020
Dress Pattern Sewing Tutorial	An app allows one to manufacture various dress models and is equipped with patterns	–	more than 5000	Halfway Home Company	English	2022

Table 1. List of mobile applications for garment manufacturing

Name	Description	User Ranking	Number of Downloads	Author	Language	Year
Sewing Course	Free sewing tutorials, tricks, and tips to quickly learn to sew and embroider at home	–	more than 1000	Rios Rosa Montana	English, Spanish, Portuguese, French, Japanese, Indonesian, Hindu	2022
Sewing Pattern Design	The application contains drawings of clothing details of various types with segment sizes	3.1	more than 100000	HRN Studios	English	2019
Tailor Course	An app gives full instructions and details about cutting and stitching, modern tailoring techniques	–	more than 50000	Hindi Infoware	English, Hindi, Gujarati, Marathi	2019
Easy Design Patterns Tutorial	An app contains a design patterns tutorial for beginners. It works offline	–	more than 1000	Warrior Tutorial	English	2021
Sewing Lessons	Simple sewing video tutorials for beginners. After watching the videos, one can learn to take measurements, draw patterns, and manufacture garments	–	more than 1000	FantasyAppS	English, Spanish, Portuguese, French, Japanese, Indonesian, Hindu	2021
Satisfying Sewing Hacks – Cutting Stitching	In this application, the authors provide sewing hacks to save your clothes. Repair tips for jeans one of the best tutorials in this app	–	more than 500	Blanca	English	2020
Easy Sewing Lessons	Sewing and embroidery video lessons for beginners	–	more than 10000	Tulipa 7789	English, Spanish, Portuguese, French, Japanese, Indonesian, Hindu	2019
Clothing and craft ideas	The app provides tricks and tips to recycle clothes and accessories in easy-to-follow tutorial videos	–	more than 10000	creativeapplications 42	English, Spanish	2019
Clothing recipes	The app contains photos with examples of simple ways to refashion clothes.	–	more than 10000	Saiyaapp	English	2017
DIY Fashion Clothes Ideas	The application provides examples for recycling any kind of clothing	–	more than 10000	KinanApps	English	2017
SINGER® Sewing Assistant	Using this app, one can get custom-made sewing tutorials for specific sewing machines and get help to discover new sewing skills with step-by-step instructions and animations	–	more than 100000	VSM Group AB	English	2019

Continued *Table 1. List of mobile applications for garment manufacturing*

Name	Description	User Ranking	Number of Downloads	Author	Language	Year
Refashion Clothes Tutorials	The app with photo tutorials on various ways to refashion clothes	3.4	more than 100000	Pitlord	English	2019
Sewing guide	Sewing guide for beginners with tutories on how to choose fabrics, and patterns, take measurements, draw designs, and manufacture garments	–	more than 10000	PEYSO CO	English	2021
Sewing for beginners	This app covers some basic hand sewing techniques with full instructions and details	4.0	39	Gooi Ah Eng	English	2020
Husqvarna Viking JoyOS	The app features sewing instructions and tutorials that sync with your mySewnet™-enabled sewing machine	3.9	58	VSM Group AB	English	2021
PFAFF® CreatorCue	The app allows one to view step-by-step sewing instructions and tutorials. Every step syncs automatically between the app and machine via the mySewnet™ account	4.1	103	VSM Group AB	English	2021

Continued *Table 1. List of mobile applications for garment manufacturing*

considered mobile applications are not sufficient to use each of them separately for a thorough study of the technology sequence for manufacturing clothes, which allows the applicant to acquire the appropriate competencies to achieve the aims of training in the specialty. The following learning outcomes declared in the national guidelines for the Bachelor's degree are the most relevant for students working with clothing design:

– LO1 Students can apply abstract thinking in solving complex, specialized problems in the manufacturing and technology of light industry products.
– LO3. Students can use modern informational systems, technologies, and general and specific software in their professional activities.
– LO6. Students can use a professional glossary and basic definitions in materials science, design, technology, and garment manufacturing, as well as their quality indexes.
– LO10. Students can collect, process, and analyze data on light industry products, their production technology, quality assessment, technical and economic indicators, and demand.
– LO13. Students can perform engineering calculations necessary to implement the professional activities based on standard methods and current regulatory documents.

Thus, the focus of the current work is a mobile app for garment manufacturing, with the help of which the student will receive the listed learning outcomes.

4. Results and Discussion

4.1. Program realization of the mobile application

The application's task is to facilitate students' work in studying the discipline "Fundamentals of Technology of Goods" in distance learning. After a student learns the theoretical part of the discipline, he can consolidate the acquired knowledge using a mobile application for performing laboratory works. The app presents new modern methods of joining elements of leather and fur garments and features of technology for processing natural and artificial fur and leather garments.

Taking into account all the advantages and disadvantages of the prototype and the results of the conducted surveys, the mobile app "TechLab" was developed using MIT App Inventor. We generate a QR code to download the program quickly (Fig. 1).

The mobile application contains six laboratory works for studying the features of manufacturing leather and fur garments. Three of them are devoted to studying manufacturing clothes made of natural and artificial leather. The other three laboratory works are related to manufacturing corresponding elements of natural and artificial fur garments.

So, the main subjects of laboratory works are: the technology for processing



Fig. 1. Icon and QR code of the mobile app "TechLab"

of pockets; technology for processing of collar, neck-front facing, and hem; technology for processing of sleeves. Every laboratory work includes 3 to 10 variants of manufacturing main product elements' design and sewing techniques (Fig. 2).

The resulting screenshots displaying the work of the app "TechLab" is given in Fig. 3.

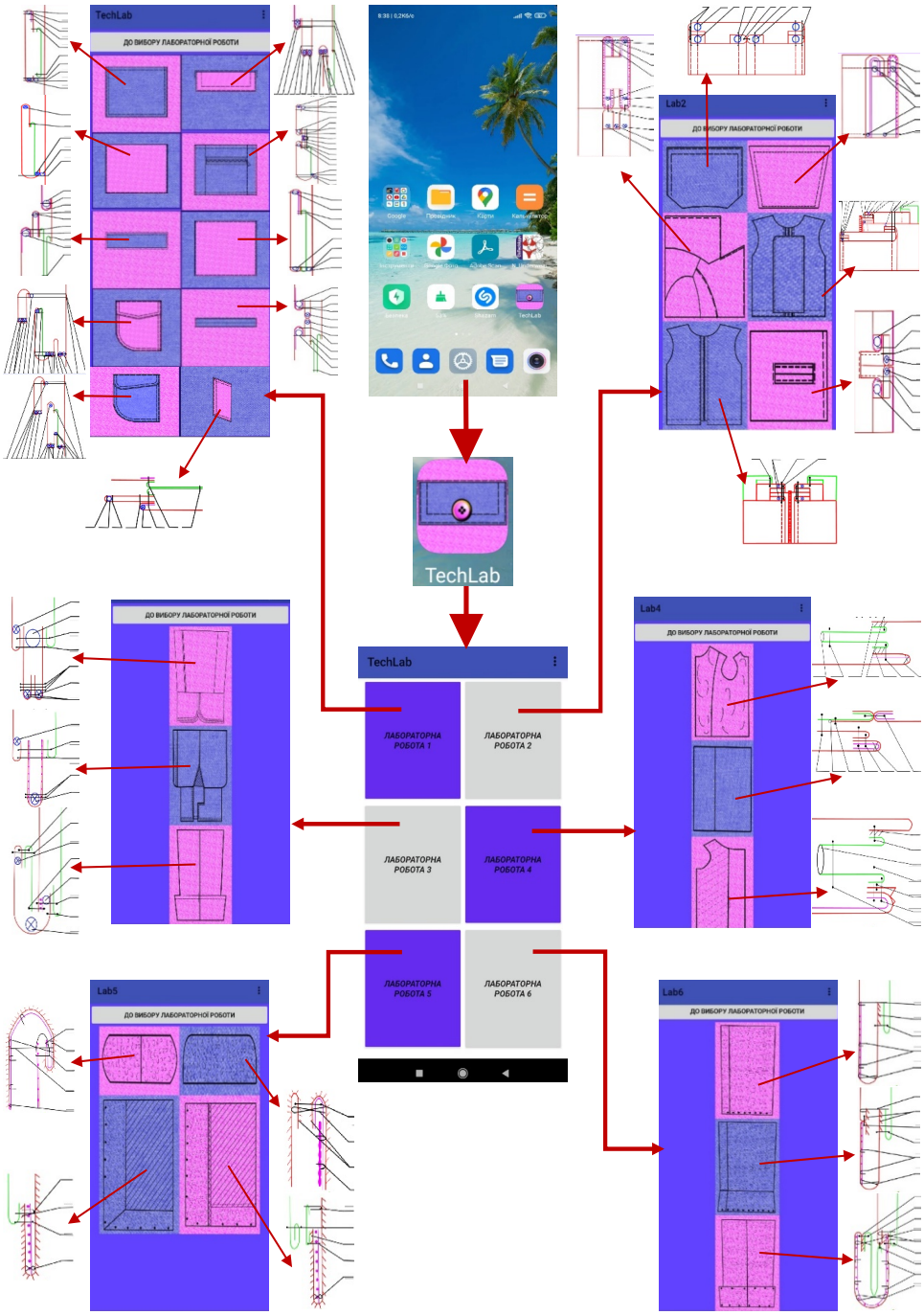


Fig. 2. Structure of the mobile app "TechLab"

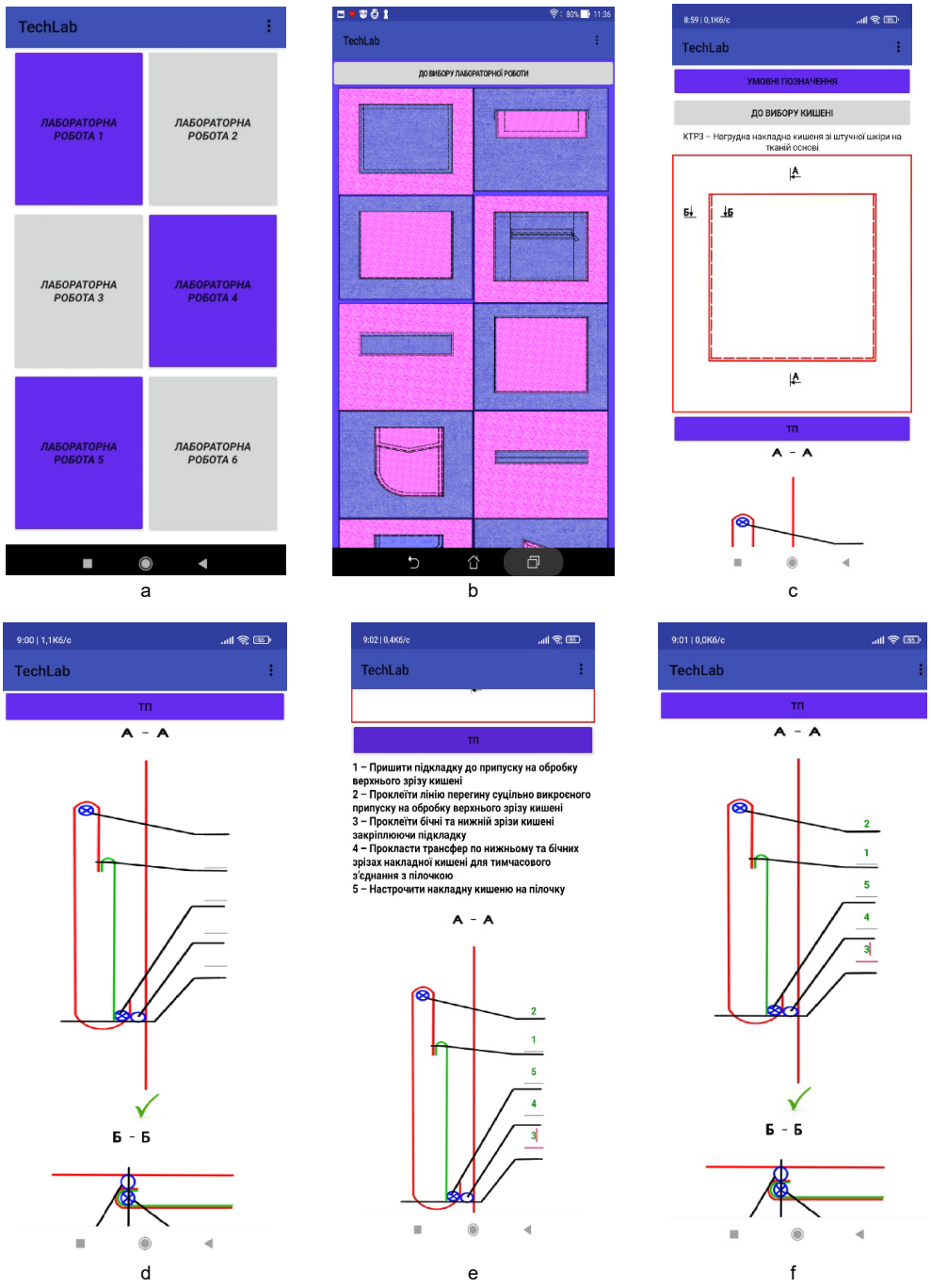


Fig. 3. Screenshots of the mobile app "TechLab": a) the list of laboratory works; b) an appearance of product elements in laboratory work; c), d) cross-sections indicated on the external view of product elements; e) technology sequence for manufacturing product elements; f) checking the correctness of the selected operations

For the beginning to work with the application, the user selects the laboratory work to be completed (Fig. 3, a). The next step is to choose a specific product element (Fig. 3, b). Each product element represents by an appearance and several cross-sections indicated on the external view (Fig. 3, c, d).

By pressing the "ТП" button, one can see a technology sequence for manufacturing product elements (Fig. 3, e). The numbers of operations in the sequence refer to all cross-sections within the product element. All assembly schemes are presented in color variants for easy understanding by the users. Color conventions are shown in each laboratory work: red – base material, green – lining material, pink – interlining, and blue – adhesives joining.

The user gets acquainted with the technology sequence for manufacturing product elements and puts the operation numbers on the scheme following the sequence. In the end, one can check the correctness of the selected operations by pressing the "green checkmark" under each section (Fig. 3, f).

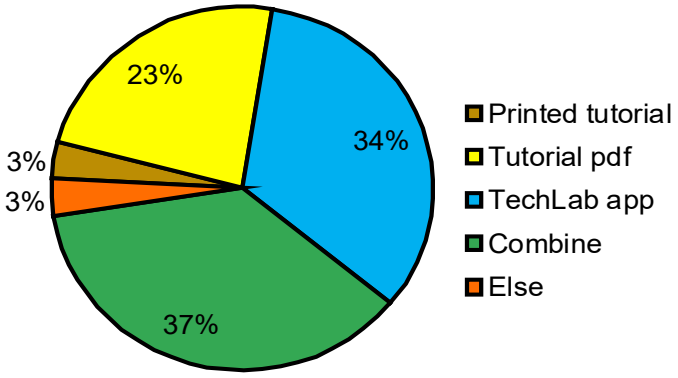


Fig. 4. The results of a survey of respondents on their use of tutorials

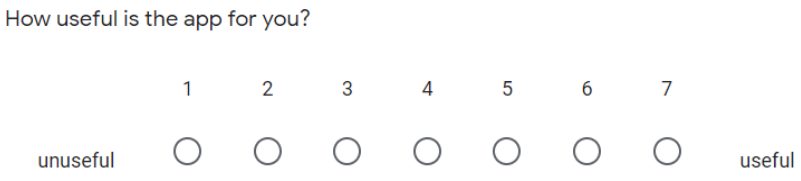


Fig. 5. Example of the questionnaire

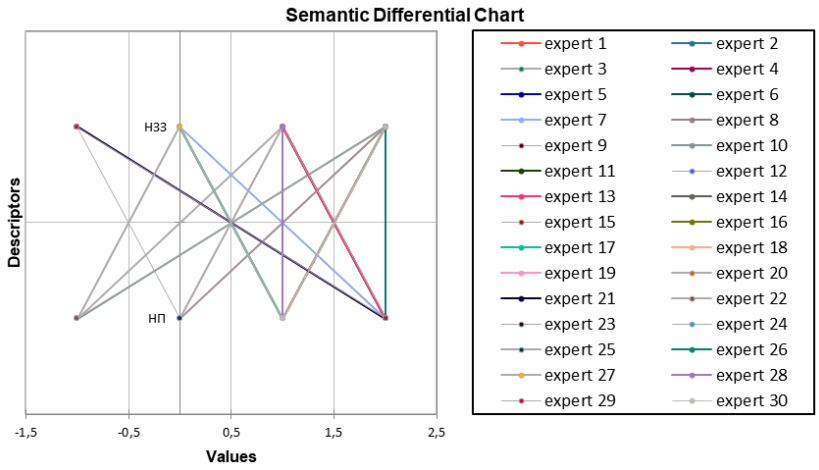


Fig. 6. Psychographic profiles of the mobile application "TechLab"

The available language of the mobile app "TechLab" is Ukrainian. After successfully testing the application in higher educational institutions, it is advisable to ensure its operation in English.

Performing laboratory work, the student strengthens theoretical knowledge, acquires the skills to represent assembly schemes for processing main product elements, and compose a technology sequence for indivisible manufacturing operations, coding seams, and stitches.

4.2. Assessment of the mobile app "TechLab"

The mobile app "TechLab" aims to form a system of professional competence by developing professional essential personality traits in students – an application for studying the features of fur and leather garments manufacturing.

We surveyed students and teachers using a questionnaire to determine the most convenient variant for working with educational materials during teaching and learning. The questionnaire offers the most popular choices for presenting guidelines: printed tutorials, an electronic version of tutorials (.pdf), an online "TechLab" app, or a combination of several options. The majority of respondents believe that the best format for tutorials will be a mobile application (34%) or a combined variant of tutorials (37%) (Fig. 4). All the experts gave positive responses to the idea of using the mobile app to study features of technology for processing elements of leather and fur garments.

The app "TechLab" we evaluate by the method of semantic differential. At the first stage of using this method, pairs of words with opposite meanings were formed, forming the semantic differential. Each pair of Kansei words is a bipolar pair for a separate attribute of the developed application. The standard coding practice uses the first letters of words with opposite meanings. The questionnaire is a scale with opposite features that characterize a mobile application: Unuseful – Useful (UnU), Impractical – Practical (IpP).

The scales look like as horizontal rulers in the questionnaire. Each scale has seven gradations of attributes expressed in numerical form (-3, -2, -1, 0, +1, +2, +3) [17-20]. Choice value 1 – the low degree of manifestation of a quality indicator, 3-5 – the average degree of the quality of the indicator, and 7 – the high degree of a quality indicator. The expert group consisted of 30 representatives of the garment industry (students, teachers, and representatives of the sector of the economy). In a survey, the app prototype was valued using evaluation factors in bipolar scales defined by verbal antonyms of KW from each end of the scale (Fig. 5).

The next step was processing survey results. As one can see from Figure 6, the application is assessed primarily with marks related to the positive meaning of Kansei Words. Thus, the survey results indicate that the experts approved the mobile application "TechLab."

In the survey, experts named advantages of using the application for studying the features of the technology for manufacturing leather and fur garments, such as access to learning at a convenient time and place for the student, simultaneous teaching of a large audience, the variety of methods for manufacturing main product elements, the clarity of the information provided, the ability to check the correctness of the completed task instantly.

The majority of respondents (68%) noted that the application is helpful for self-control of students' knowledge.

5. Conclusion

The application is the only one on the market of mobile applications devoted to studying the features of the technology sequence for manufacturing elements of natural and artificial fur and leather clothes.

Using MIT App Inventor, we developed the mobile app "TechLab" for Android OS. The app "TechLab" is available at the following link: https://play.google.com/store/apps/details?id=appinventor.ai_zbirvukladach.TL1&hl=ru&gl=US.

The most prominent advantages of the app "TechLab" are to support learning the peculiarities of sewing techniques of leather and fur garment manufacturing, promote faster assimilation of information, and self-control of students' knowledge. Using a mobile app helps students achieve the primary learning outcomes declared in the national guidelines for the Bachelor's degree.

An expert group of teachers and students studying the garment industry and clothing designers tested the app. Based on the survey results, the app's competitiveness is prominent.

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