The Development of Android-Based Learning Media for the CAD Pattern Making Course at Universitas Negeri Padang

Meidina Hastuti[1*], Ernawati[2], Weni Nelmira[2], M. Giatman[1]

[1] Faculty of Engineering, Universitas Negeri Padang, Padang, Indonesia
[2] Faculty of Tourism and Hospitality, Universitas Negeri Padang, Padang, Indonesia

Abstract: This research aims to develop Android-based learning media in the CAD Pattern Making course in response to students' difficulties in understanding the functions of certain tools, such as pleats and cut a part, used in drawing fashion patterns digitally. Previous learning media in the form of video tutorials and job sheets in UNP e-learning are considered less interactive and difficult to access through Android devices, even though the majority of students use Android smartphones in the learning process. This research uses the Research and Development (R&D) method with the 4D development model (Define, Design, Develop, Disseminate), but is limited to the development stage. Media validity was tested by three media experts and three material experts using a validation sheet instrument and analyzed by Aiken's V formula. The validation results showed a score of 0.95 from media experts and 0.99 from material experts, including a very valid category. The developed application presents material in the form of text, videos, interactive quizzes, job sheets, and discussion features. The results of the study indicate that the media is suitable in terms of content and design for use in the context of learning CAD pattern making in the D3 Fashion Design study program at Padang State University.

Keywords: Android; CAD Pattern Making; Learning Media

Introduction

Education plays an important role as one of the main determinants of the quality of life of the population and the future of a nation (Hidayat & Wahyudi, 2023). Good quality education will produce the next generation that is competent and able to contribute to the advancement and welfare of the nation (Rahmawati & Nelmira, 2025a; Syafrina & Nelmira, 2019). Therefore, investment in quality education is crucial to ensure that the nation can achieve sustainable progress (Budi & Sukmono, 2023; Safitri et al., 2022). In Indonesia's national education system, education starts from primary to higher education (Sari & Fitri, 2021). Each level has a strategic role in shaping the character and abilities of students (Afrianti et al., 2015; Oktarina et al., 2021). Higher education, as the culmination of the formal education system, has a great responsibility in preparing students to become individuals who are not only knowledgeable, but also have professional expertise that is ready to be applied in various fields (Irfan et al., 2023).

Higher education plays a crucial role in the development and dissemination of science and technology in society (R. Putri & Nugraha, 2023). Higher education institutions not only function as places of formal learning, but also as centers of innovation that encourage the advancement of various disciplines (Nugroho & Fitriani, 2021). Thus, higher education is expected to make a significant contribution in developing knowledge that can be applied directly to the advancement of society, creating innovative solutions, and enriching the quality of life (Ma, 2021; Nurjanah & Suprihatin, 2023; Zhang & Zhou, 2021).

More than just academic achievement, higher education plays a role in producing human resources who are not only intellectually intelligent but also have the practical ability to apply science and technology in everyday life (Kurniawan & Darmawan, 2022). Universities are expected to be able to integrate theory with practice, so that the graduates produced not only have in-depth knowledge but are also able to contribute significantly in various fields (Nelmira, 2014). This includes the ability to create innovations that are relevant and have a direct impact on improving the welfare of society (Amiruddin et al., 2024; Wulandari, 2022). Therefore, higher education is one of the main pillars in nation building. Higher education has a great responsibility in shaping individuals who are ready to face global challenges and contribute to sustainable development (Irwansyah & Yusuf, 2022; Jannah & Mulyadi, 2021). With a focus on developing knowledge that benefits society, higher education plays a role in creating a generation that not only excels academically but also has ethics, social responsibility, and the ability to drive positive change in society (Afifah et al., 2021).

University Negeri Padang (UNP) is one of the state universities in West Sumatra which has 10 faculties, one of which is the Faculty of Tourism and Hospitality (FPP). In FPP there is a Department of Family Welfare Science which houses the D3 Fashion Design study Program (Andriani & Kurniawan, 2020). This study program aims to equip students with competencies in the field of fashion styling so that graduates can be absorbed by the world of work (Ernawati et al., 2022; Fitriani et al., 2016). To achieve this goal, it is necessary to improve the quality of education, one of which is by strengthening the learning process through the use of effective learning media, both in online and offline learning (Ernawati et al., 2023; Ernawati, 2022).

According to Batubara (2020), media comes from Latin medius which means intermediary. Learning media is a means used to convey teaching material from educators to students. Wulandari et al. (2023) added that learning media facilitates the delivery of complex material to be clearer and more interesting, increases students' interest and understanding, and supports effective and interactive learning (Aini & Wahyuni, 2022; Amir, 2022). The use of appropriate media can also build learners' appreciation of the material, encourage involvement, and strengthen positive attitudes towards the learning process. Hasan et al. (2021) stated that learning media not only facilitates the teaching-learning process, but is also able to improve student focus, motivation, and learning outcomes (Fadilah & Sukardi, 2021; Harahap & Siregar, 2022). Visual, audio, and interactive media can help students understand difficult concepts and apply them in a real context. Along with the advancement of information and communication technology (ICT), the utilization of multimedia and the internet in learning becomes wider and more effective (Bakhri et al., 2023).

One of the learning media that is relevant to current ICT developments is Android-based media. Android is the most widely used operating system by students because it supports quick access to interactive learning applications (Chen & Tsai, 2022). Android-based learning media allows the presentation of material in the form of text, images, audio, video, quizzes, and games. In addition, this media supports learning flexibility because it can be accessed anytime and anywhere through devices owned by students (Ferreira & al., 2023).

The CAD Pattern Making course is a compulsory course in the D3 Fashion Design study Program which studies computer-based fashion pattern making using software such as Richpeace (Fitria et al., 2021; B. D. Putri & Ernawati, 2022). The material includes understanding the concept of tools, using tools such as pleats, cut a part, and making patterns of sleeves, blazers, kebaya, and others (Hasanah & Wulandari, 2022; Mardian et al., 2023). Based on the Semester Learning Plan (RPS) document, learning CAD Pattern Making requires an understanding of many digital tools that are still difficult for students to master. The learning media currently used are video tutorials and job sheets uploaded on UNP e-learning (Nurlaili & Sudarmawan, 2021). However, this media is not optimal because it is not designed for Android devices commonly used by students. The interface is less responsive, the content is not interactive, and access via smartphones is inefficient (Nabella & Dwiningsih, 2022; Panerus et al., 2024).

Based on initial observations of students and lecturers, students' biggest difficulty lies in understanding the functions of CAD tools, especially when creating pattern ruptures and setting parameters in Richpeace software. In addition, limited face-to-face time encourages the need for self-learning media that can be accessed at any time. Students need an application that is concise, interactive, and can help them repeat the material without depending on the lecturer (Rahmawati & Nelmira, 2025b). For this reason, it is necessary to develop Android-based learning media that is able to summarize material in accordance with the RPS, is easily accessible, and supports independent learning. The developed application will present content in the form of text, images, video tutorials, digital job sheets, quizzes, and game features to increase understanding and motivation to learn. This media is expected to be a solution to the problem of the effectiveness of the previous media and support the achievement of more optimal learning outcomes.

The novelty of this research lies in the development of an Android-based application specifically designed

for CAD Pattern Making learning in a vocational environment, using a 4D model approach, and presenting interactive features that are not yet available in previous e-learning media. Not only emphasizing the delivery of material, this media also integrates evaluative aspects (quizzes and games) to support active student involvement. This makes this research different from previous research which is only limited to video or module-based media.

.

Method

Research This research uses the Research and Development (R&D) method with the 4D development model developed by Thiagarajan, Semmel, and Semmel (1974), which consists of four main stages: Define, Design, Develop, and Disseminate (Pratama K., A. et al., 2024; Pratama et al., 2025). However, in this study, development is limited to the Develop stage, namely until the validation of the learning media by experts. The practicality test, limited trial, and dissemination stages are not included in the scope of this study (Prima et al., 2023; Renny, 2024).

To clarify the procedural flow used in this study, the following is a flow diagram of the Android-based learning media development procedure :
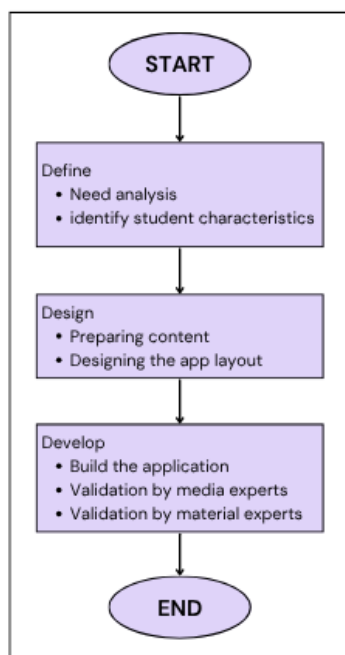

Figure 1. Development procedure flowchart

The stages of the Android-based learning media development procedure follow the first three stages in the 4D model, with the following explanation :

Define Stage

This stage aims to identify learning needs and student characteristics as a basis for media development. Activities carried out include: Needs analysis, conducted through interviews with lecturers in charge of CAD Pattern Making courses, study of Semester Learning Plan (RPS) documents, and observation of the learning process. Identification of student characteristics, including Android smartphone usage habits, level of technology mastery, and general difficulties in understanding CAD tool functions such as pleats and cut a part (Suryani et al., 2018; Winarto & Said, 2021b).

Design Stage

This stage aims to design the content and interface of the learning media. Activities carried out include: Preparation of material content, taken from teaching modules, textbooks, and RPS for the CAD Pattern Making course. The material is packaged in the form of narrative text, images, video tutorials, job sheets, and quizzes and games. The design of the application layout is carried out using the Flutter platform, which supports Android systems at least version 5. The interface design emphasizes the principles of ease of navigation, readability, and an attractive and educational appearance (Akhsan et al., 2023; Winarto & Said, 2021a).

Development Stage

This stage involves media development and validation to assess the feasibility of the application's content and technical aspects. Making a prototype application based on the design that has been designed. Activities carried out include: Product validation by experts, involving three material experts and three media experts (Astuti et al., 2021).

The criteria for selecting experts include a minimum educational background of S2, experience in CAD Pattern Making (for material experts), and digital media development (for media experts). Validation is carried out using an assessment sheet with a 5-point scale, covering aspects of content, visual appearance, language, technical, and suitability to learning objectives. Validation data from the validation results are analyzed using the Aiken's V Validity Coefficient, where a score between 0.81 and 1.00 is categorized as very valid (Kusuma & Prasetyo, 2020; Yunita & Prasetyo, 2023).

Results and Discussion

This study aims to produce Android-based learning media in CAD Pattern Making courses with high levels of validity, practicality, and effectiveness. The development model used in this study is the 4D model (Define, Design, Develop, Disseminate). However, this study is limited to the Develop stage, namely validation

by experts and trials of the practicality and effectiveness of the media, before the media is widely disseminated.

Define Stage

The define stage is the initial step in the process of developing Android-based learning media with the aim of systematically identifying learning needs, user characteristics, and important components in media design. This stage is the basis for designing products that are right on target, effective, and relevant to the learning context in the D3 Fashion Design Study Program, Padang State University. Activities in this stage include the following five main analyses:

Needs Analysis

Needs analysis was conducted to explore the problems faced by students in participating in CAD Pattern Making learning. The techniques used were direct observation and open questionnaires to students who had attended the lecture. The results showed that students had difficulty in understanding the function of certain tools in CAD software, especially tools such as pleats and cut a part. Students also stated that they often forgot the function of each tool when working on pattern making assignments. The learning media currently available, such as video tutorials and job sheets on the UNP e-learning platform, are considered less interactive and not optimally accessed via Android smartphones, even though this device is the most common tool used by students in learning activities. The difficulty of access and limitations of these media are the main background for the need to develop learning media that are Android-based, interactive, and support independent learning.

Student Characteristics Analysis

The subjects of the study were students of the D3 Fashion Design Study Program who were taking the CAD Pattern Making course in the January–June 2025 semester, with an age range of 19 to 22 years. Students have varying educational backgrounds, which also affect their learning speed and style for technical materials such as CAD. In their daily lives, they tend to actively use Android-based smartphone devices both for communication and access to learning materials. This habit shows that learning media designed for Android will have high reach and a good level of acceptance by students.

Task Analysis

This analysis was conducted by reviewing the Sub-Course Learning Outcomes (Sub-CPMK) listed in the Semester Learning Plan (RPS). Based on the results of the review, learning media were designed to include learning tasks in the form of practice questions (quizzes) and educational games that are adjusted to the content of the material. These tasks aim to strengthen students' understanding of the use of tools in CAD Pattern Making, as well as being an internal evaluation instrument that encourages active student involvement..

Concept Analysis

At this stage, identification and selection of basic concepts that will be used as the main material in the media are carried out. The concepts are taken from the CAD Pattern Making textbook, other academic references, and official RPS documents from the course. The material focuses on understanding the use of CAD tools, the application of digital pattern making concepts, and the practice of making various clothing patterns with the help of Richpeace software. These concepts are arranged to suit the cognitive level of vocational students and support the expected learning achievements.

Learning Objective Analysis

The Learning objectives are formulated based on the learning outcomes of the course and the graduate profile that the study program wants to achieve. The main objective is for students to master the concept of digital fashion pattern making using CAD software, and be able to apply this knowledge in completing fashion pattern design tasks independently and professionally. This objective is the basis for determining the content structure, media types, and evaluation strategies that will be included in the Android-based learning application.

Design Stage

The Design stage is an important phase in the development of Android-based learning media because at this stage, careful planning is carried out regarding the media to be built, both in terms of technical aspects and learning content. The goal is to produce an initial design of media that is relevant, easy to use, and in accordance with the needs of CAD Pattern Making learning.

Media Selection

Learning media is developed using Flutter, an open-source framework that enables the development of Android applications with a single code base for multiple platforms. Flutter was chosen because it has many advantages, including supporting a responsive user interface, being compatible with Android version 5 and above, saving time and money, and enabling the integration of various multimedia components such as text, images, navigation buttons, video, and audio. Flutter also makes it easy for developers to create attractive and interactive interfaces, which are essential

in the context of visual learning such as CAD Pattern Making.

Media Content Selection

The content of the learning media is systematically arranged based on the Sub-Course Learning Outcomes (Sub-CPMK) that have been determined in the Semester Learning Plan (RPS). The material is presented in the form of interactive multimedia designed to make it easier for students to understand the concepts in the CAD Pattern Making course. The presentation format of the material includes video tutorials that show the steps for using various tools in the CAD Pattern Making software, narrative texts that explain concepts and procedures descriptively, and multiple-choice quizzes that function as evaluation tools to measure students' understanding of the material that has been studied. In addition, educational games are also provided as a form of interactive evaluation to increase student motivation and involvement in the learning process. Each Sub-CPMK is equipped with assignments or exercises, so that this media not only delivers learning content, but also encourages students to actively work on in-depth learning activities that are oriented towards achieving overall competencies.

Preparation of Assessment Instruments

The preparation of assessment instruments in this study was carried out to measure three main aspects of the Android-based learning media developed, namely validity, practicality, and effectiveness. The validity instrument was prepared in the form of a questionnaire using a Likert scale, which was then analyzed using the Aiken's V coefficient to assess the extent to which the content, design, and technical aspects of the media were in accordance with the learning objectives. Meanwhile, the practicality instrument was designed to evaluate the ease of use and usefulness of the media from the perspective of users, both lecturers and students. Practicality measurements were carried out through trials in small groups and large groups to obtain input from various levels of user ability. The effectiveness instrument was in the form of multiple-choice questions used to measure student learning outcomes in two groups: the experimental class using Android-based media and the control class using conventional learning media. Before being used in testing, these questions were first tested to ensure validity, reliability, level of difficulty, and discrimination in order to provide accurate and representative evaluation results.

Initial Application Design

The initial application design is designed in the form of a prototype consisting of several main pages. Each page has a specific function that supports the student's independent learning process. The components in this application design include:
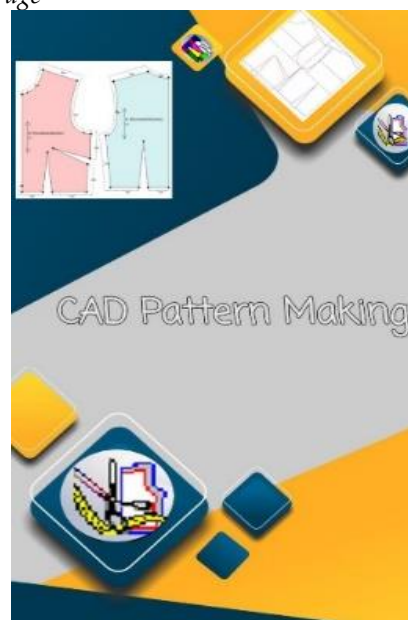
Welcome Page

Figure 2. Welcome page

This is the initial page that appears when the application is opened. This page contains the application title and illustrative images related to CAD Pattern Making.
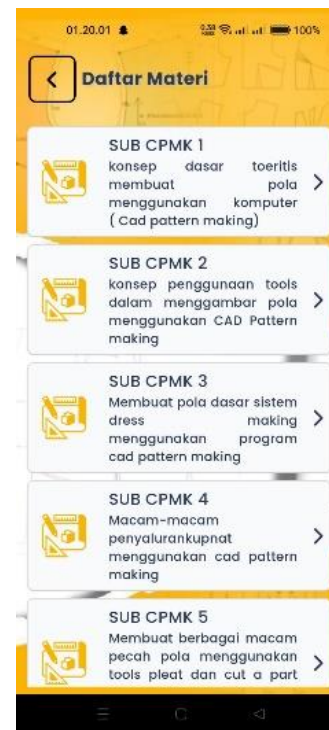
Main Menu Page

Figure 3. Main menu page

This page provides the main navigation to various learning features. There are important buttons such as Home, Materials, Discussion, and App Info.

Home Page

Figure 4. Home page

On this page there are four main buttons the main features on the Home page of this Android-based learning media consist of four interactive components designed to support students' independent learning process. First, the Tutorial feature functions to display a video guide on how to install and operate CAD software, so that students can understand the basic technical steps before starting to draw patterns digitally. Second, the Material feature presents learning videos that are structured according to the Sub-Course Learning Outcomes (Sub-CPMK), equipped with assignments designed to deepen students' understanding of the concepts being studied. Third, the Jobsheet feature provides worksheets that can be used directly by students, as a means of applicable practice in drawing patterns using CAD Pattern Making. Finally, the Quiz feature contains 20 multiple-choice questions, with answer options A to E, which function as a learning evaluation to measure students' understanding of the material that has been studied systematically and comprehensively.

Material Page

Figure 5. Material Page

Provides a list of materials that can be studied according to the Sub-CPMK structure that has been prepared in the RPS.

Discussion Page

Figure 6. Discussion Page

This page is equipped with a button that is directly connected to the WhatsApp group, allowing students to discuss in real-time with lecturers and classmates.

App Page (About App)

Figure 7. App page

Provides general information about the purpose, developer, and usage guidelines for the learning app that has been designed.

Development Stage

The Develop stage is the core phase in the process of developing Android-based learning media, which aims to produce valid, practical, and effective products before being applied in learning the CAD Pattern Making course. At this stage, application prototypes are made, validated by experts, and practicality and effectiveness trials of the developed media are carried out.

Validation of Learning Media

Table 1. Validation Results of Android-Based Learning Media for CAD Pattern Making Course

Assessment Aspect	Aiken's V Value	Validity Category
Media Experts	0.95	Very Valid
Material Expert	0.99	Very Valid
Average	0.97	Very Valid

The validity of Android-based learning media in the CAD Pattern Making course was assessed by experts consisting of three media expert validators and two material expert validators. Based on the validation results using the Aiken's V coefficient, an average value of 0.95 was obtained from media experts and 0.99 from material experts, both of which were included in the very valid category. Overall, the average value of media validity reached 0.97, which indicates that the developed learning media is very feasible to be used in the learning process.

During the validation process, the validators also provided a number of suggestions for improvement that have been followed up by the researchers. These improvements include the addition of a clarification button in the quiz section, adjusting the display layout to be more intuitive and attractive, and removing running text in the learning video which is considered to be able to disrupt students' focus while learning. The implementation of these suggestions not only improves the quality of the display and function of the media, but also strengthens the suitability of the content and usability of the media with learning objectives. Thus, the learning media developed has met the validity criteria in terms of content, design, and technicality.

Practicality Test

Table 2. Practicality Test Results of Android-Based Learning Media

Respondent Group	Average Practicality Score (%)	Category
Lecturer	94	Very Practical
Low Ability Students	78	Practical
Medium Ability Students	100	Very Practical
High Ability Students	87	Very Practical
Average Students	88	Very Practical
Average Total	91.3	Very Practical

The practicality test of Android-based learning media in the CAD Pattern Making course was conducted in two stages, namely in small groups and large groups. In the small group stage, practicality was tested by involving lecturers and students with different levels of ability (low, medium, and high). The results of the assessment by three lecturers showed that this media obtained an average practicality score of 94%, which is included in the very practical category. This assessment includes aspects of ease of use, effectiveness of learning time, and suitability of the media to learning needs.

Meanwhile, the practicality test by students was conducted on three groups based on their ability level. Students with low ability gave an average score of 78%, which is included in the practical category. Students with medium ability gave an assessment of 100%, which indicates that this media is very practical to use. Meanwhile, students with high ability gave a score of 87%, also in the very practical category. Overall, the practicality test by students produced an average score of 88%, indicating that this media is very practical to use by students with various levels of academic ability. These results indicate that the developed learning media can be accessed and utilized optimally by lecturers and students in the learning process.

Effectiveness Test

The effectiveness test of Android-based learning media in the CAD Pattern Making course was conducted using a quasi-experimental design and independent sample t-test statistical analysis. This study involved two groups of students, namely the experimental class using Android-based learning media and the control class using conventional learning media in the form of video tutorials and jobsheets on the e-learning platform.
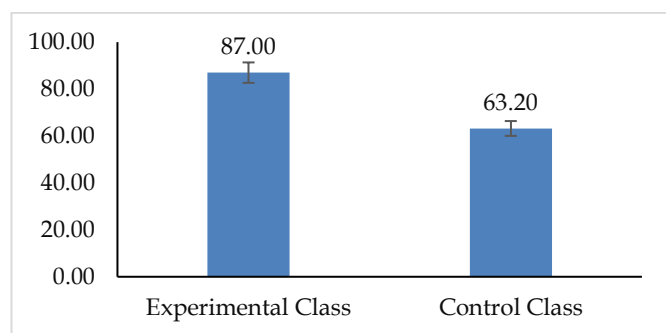

Figure 8. Comparison diagram of posttest results of two classes

The diagram above presents a comparison of posttest results between two groups of students in the research on the development of Android-based learning media in the CAD Pattern Making course. The experimental class, which used Android-based learning media, obtained an average score of 87, while the control class, which used conventional methods in the form of video tutorials and job sheets in e-learning, only obtained an average score of 63.2. This significant difference indicates that the use of Android-based media is more effective in improving student learning outcomes. Interactive media, easily accessible through devices familiar to students, and equipped with materials in the form of text, video, quizzes, and games, contribute directly to a deeper understanding of the CAD Pattern Making concept. Thus, the learning media developed is not only feasible, but also has a real impact in encouraging more optimal learning achievements.

Conclusion

This study aims to develop valid Android-based learning media for use in the CAD Pattern Making course at the D3 Fashion Design Study Program, Padang State University. Based on the validation results by media experts and material experts, the developed media was declared very valid with an average Aiken's V value of 0.97, so that the research objectives have been achieved. This media presents material in the form of text, video, images, quizzes, and games that support visual, interactive, and flexible learning. High validity indicates that this media has great potential to improve student understanding, especially in mastering the functions of CAD tools that were previously difficult to understand. In addition to increasing learning accessibility, this media also encourages student learning independence and can be an alternative digital-based learning that is relevant to the needs of current vocational education. As an implication, this media can be integrated into the formal learning system to strengthen student learning outcomes. This study also suggests that further testing be carried out on a wider scale, as well as developing additional features, such as learning analytics or content personalization, to optimize the effectiveness of the media in the long term.

Author Contributions
This research article was written by four authors with their respective contributions: Conceptualization, M.H and E; methodology, M.H and E; formal analysis, M.H; data curation, M.H; writing-original draft, M.H; writing review, literature review, and editing, reviewers W.N and M.G All authors have read and approved the published version of the manuscript.

Conflicts of Interest
No conflicts of interest are disclosed by the writers.

References

Afifah, A., Nurohman, S., & Maryanto, A. (2021). Interactive learning media on Android assist. *Jurnal Pendidikan Sains*, *5*(2), 10–15. https://doi.org/10.21831/jser.v5i2.44288

Afrianti, D., Ernawati, & Nelmira, W. (2015). Pengembangan Modul Aplikasi Komputer Dalam Mendesain Ragam Hias Menggunakan Program Coreldraw X4 Untuk Mahasiswa Jurusan Kesejahteraan Keluarga Fakultas Teknik Universitas Negeri Padang. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, *16*(2), 39–55. Retrieved from https://shorturl.asia/HZhUz

Aini, Z. N., & Wahyuni, I. (2022). Pengembangan aplikasi Android pada materi dynamic block di AutoCAD. . *Jurnal Pendidikan Teknik Sipil Dan Perencanaan*, *8*(1), 45–56. Retrieved from https://ejournal.upi.edu/index.php/JPTB/article/viewFile/63739/pdf

Akhsan, H., Yusup, M., Ariska, M., Husna, T., & Sari, D. K. (2023). Dry Lab AR to overcome

misconceptions. *JPPIPA* , 4(2), 37–43. https://doi.org/10.14733/CADAPS.2021.S4.49-60

Amir, S. (2022). Evidence-based study on teaching CAD: Lessons from pandemic shift. *Education Sciences*, 12(1), 29. https://doi.org/10.3390/educsci12010029

Amiruddin, A., Surahman, E., & Rochman, C. (2024). The application of a multimedia-assisted problem-based learning model based on Android to enhance students' critical thinking skills. *JPPIPA*, 10(2), 88–98. https://doi.org/10.26740/jppipa.v10n2.p88-98

Andriani, L., & Kurniawan, A. (2020). Android-based e-module development for CAD. *Jurnal Ilmiah Pendidikan Teknik Elektro* , 9(1), 33–38. https://doi.org/10.33369/jipte.v9i1.12225

Astuti, A., Nisa, K., & Fitriana, R. (2021). Augmented reality-based Android learning media on 3D CAD design. *Jurnal Pendidikan Teknologi Dan Kejuruan* , 28(2), 145–152. https://doi.org/10.21831/jptk.v28i2.45345

Bakhri, S., Tsuroya, N. H., & Pratama, Y. (2023). Development of learning media with QuickAppNinja Android-based. *JPPIPA*, 9(7), 4879–4884. https://doi.org/10.29303/jppipa.v9i7.3574

Budi, Y. E. P., & Sukmono, T. (2023). Effectiveness of CAD-CAM application for maintenance tools. *JPPIPA*, 9(9), 671–680. https://doi.org/10.29303/jppipa.v9i9.4859

Chen, L., & Tsai, C. (2022). Interactive Android app for STEM-CAD integration. *Journal of Computer Assisted Learning*, 38(5), 1234–1245.

Ernawati, E. (2022). Fashion design education students' ability to create fashion patterns: investigating the effect of antecedent factors. *JPPI (Jurnal Penelitian Pendidikan Indonesia)*, 8(02), 312–319. https://doi.org/10.29210/020221733

Ernawati, Hidayat, H., Primandari, S. R. P., Ferdian, F., & Fitria, R. (2022). The Empirical Study of Factors Affecting Students' Competence of Fashion Design Education in the Industrial Revolution 4.0 Era. *International Journal of Instruction*, 15(4), 259–276. https://doi.org/10.29333/iji.2022.15415a

Ernawati, Tasrif, N., Ferdian, F., & Andres, S. (2023). Cognitive and Psychomotor on University Student Study Outcome in Apparel Basic Pattern making Using CAD. In R. H. E. Sendouw (Ed.), *Kepuasan Pelanggan & Pencapaian Brand Trust* (pp. 149–155). UNICSSH. https://doi.org/10.2991/978-2-494069-35-0-19

Fadilah, R., & Sukardi, R. (2021). CAD tools utilization in vocational schools. *Jurnal Pendidikan Vokasi* , 11(3), 245–255. https://doi.org/10.21831/jpv.v11i3.45654

Ferreira, J., & al., et. (2023). Mobile learning for visual design: Effectiveness in CAD usage. *International Journal of Mobile Learning*, 15(2), 101–119. Retrieved from https://shorturl.asia/ZLav4

Fitria, R., Marta, R., Suci, P. H., & Ernawati. (2021). Validity of Women's Clothing Patterns Learning Video With Cad Pattern Making. *Jurnal Pendidikan Dan Keluarga*, 13(02), 89–102. https://doi.org/10.24036/jpk/vol13-iss02/983

Fitriani, D., Ernawati, & Novrita, S. Z. (2016). Implementation of The Health and Safety of Students in the Subject Batik Textile Craft Workshop Production Design State 8 SMK Padang. *Journal of Home Economics and Tourism*, 1–5. Retrieved from https://shorturl.asia/fr82P

Harahap, M. I., & Siregar, H. (2022). Integrasi media berbasis Android dalam pembelajaran teknik gambar. *Jurnal Teknik Dan Vokasi* , 6(2), 56–64. https://doi.org/10.31294/jtv.v6i2.5118

Hasanah, S., & Wulandari, V. (2022). Pengembangan media Android untuk desain visual komunikasi. *Jurnal Teknologi Pembelajaran Indonesia*, 11(1), 1–15. https://doi.org/10.23887/jurnal_tp.v11i1.613

Hidayat, F., & Wahyudi, E. (2023). Augmented Android CAD-based learning media. *Jurnal Edukasi Dan Desain* , 5(1), 13–21. https://doi.org/10.23971/jed.v5i1.6521

Irfan, M., Suratman, D., Fitriawan, D., Mirza, A., & Pasaribu, R. L. (2023). Pengembangan media pembelajaran berbasis Android untuk materi program linear. *Jurnal Pendidikan Dan Matematika (JPMI)*, 7(1), 59–67. https://doi.org/10.22460/jpmi.v7i1.21634

Irwansyah, A., & Yusuf, I. (2022). Interactive Android app for vector drawing in engineering design. *Jurnal Rekayasa* , 18(3), 123–131. https://doi.org/10.31294/jr.v18i3.5843

Jannah, R., & Mulyadi, H. (2021). Pengaruh media Android dalam pembelajaran vektor CAD. *Jurnal Edukasi Elektro* , 7(2), 55–60. https://doi.org/10.20885/jee.vol7.iss2.art4

Kurniawan, H., & Darmawan, M. A. (2022). Integration of STEM in Android-based CAD. *Jurnal Pendidikan STEM* , 3(2), 145–152. https://doi.org/10.31002/stem.v3i2.5312

Kusuma, H., & Prasetyo, R. (2020). Android application for self-learning CAD drawing. *Jurnal Inovasi Pendidikan* , 12(1), 33–41. https://doi.org/10.21831/jip.v12i1.29833

Ma, L. (2021). Multimedia simulation-based architecture CAD system model. *Computer-Aided Design and Applications*, 18(S1), 53–64. https://doi.org/10.14733/CADAPS.2021.S1.53-64

Mardian, F., Yani, A. T., & Siregar, N. (2023). Pengembangan media pembelajaran flipbook

berbasis Android untuk lingkaran dan garis singgung. *VOX*, *9*(4), 1–11.

Nabella, D., & Dwiningsih, K. (2022). M-Learning voltaic cell sub materials. *JPPIPA*, *8*(1), 183–187. https://doi.org/10.29303/jppipa.v8i1.1243

Nelmira, W. (2014). Pengembangan Cd Interaktif Untuk Media Pembelajaran Mata Kuliah Grading Jurusan Busana Universitas Negeri Padang. *PAKAR Pendidikan*, *12*(2), 188–196. https://doi.org/10.24036/pakar.v12i2.147

Nugroho, Y., & Fitriani, D. (2021). Android app-based training media for AutoCAD. *Jurnal Pengajaran Teknik*, *14*(1), 19–26. https://doi.org/10.21009/jpt.141.03

Nurjanah, F., & Suprihatin, S. E. (2023). Pengembangan media pembelajaran berbasis Android untuk pola busana menggunakan Kodular. *Jurnal Pendidikan Vokasi*, *13*(3), 232–245. https://doi.org/10.21831/jpv.v13i3.54542

Nurlaili, F., & Sudarmawan, M. (2021). The effect of Android-based learning media on student outcomes. *Jurnal Kependidikan*, *9*(2), 81–89. https://doi.org/10.21831/jk.v9i2.45678

Oktarina, S., Ernawati, & Nelmira, W. (2021). *Pengelolaan Lembaga Kursus Pelatihan Bordir di Kota Solok (Studi Kasus pada Lembaga Kursus Pelatihan Bordir Muslimah Group)*. 167–186. Retrieved from https://shorturl.asia/cm59E

Panerus, A. C., Irianti, A. H. S., & Prahastuti, E. (2024). Development of iSpring-based learning media using Android to increase learning independence. *Edunesia Jurnal Ilmiah Pendidikan*, *5*(2), 619–639. https://doi.org/10.51276/edu.v5i2.727

Pratama K., A., A. J., Maksum, H., & Wulansari, R. E. (2024). Android interaktif untuk teknik dasar otomotif. . *JPPIPA*, *10*(7), 4376–4387. https://doi.org/10.29303/jppipa.v10i7.7567

Pratama, T. A., Waris, & Gita, R. S. D. (2025). 7 Minutes Workout Android untuk motivasi siswa SMP. *JPPIPA*, *11*(4), 707–713. https://doi.org/10.29303/jppipa.v11i4.10614

Prima et al., S. (2023). Analysis of science Android-based games. *JPPIPA*, *9*(9), 4266. https://doi.org/10.29303/jppipa.v9i9.4266

Putri, B. D., & Ernawati, E. (2022). Pengembangan Video Tutorial Pola Lengan Menggunakan Rp-Dgs Cad Pattern Making. *Edutech*, *21*(3), 202–213. https://doi.org/10.17509/e.v21i3.50545

Putri, R., & Nugraha, A. (2023). Evaluation of Android-based AutoCAD learning applications. *Jurnal Inovasi Pendidikan Vokasi*, *6*(1), 50–58. https://doi.org/10.21009/jipv.061.07

Rahmawati, L., & Nelmira, W. (2025a). Pengembangan Media Video Tutorial Pembuatan Pola Bolero Berbasis Artificial Intelligence Pada Mata Pelajaran Costume Made Kelas XI SMKN 1 Ampek Angkek. In *Jurnal Ilmiah Profesi Pendidikan* (Vol. 10, Issue 1, pp. 382–390). https://doi.org/10.29303/jipp.v10i1.3099

Rahmawati, L., & Nelmira, W. (2025b). Pengembangan Media Video Tutorial Pembuatan Pola Bolero Berbasis Artificial IntelligencePada Mata Pelajaran Costume MadeKelas XI SMKN 1 Ampek Angkek. *Jurnal Ilmiah Profesi Pendidikan*, *10*(1), 382–390. https://doi.org/10.29303/jipp.v10i1.3099

Renny, D. (2024). Optimisasi Android sebagai media pembelajaran berbasis challenging task. *Jurnal Mitra Prima*, *6*(1), 1–13. https://doi.org/10.34012/mitraprima.v6i1.5420

Safitri, N. K., Sugiyem, S., & Arviana, S. I. (2022). Analisis sikap belajar siswa dalam pembelajaran CAD pattern making. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *29*(2). https://doi.org/10.21831/jptk.v29i2.58546

Sari, P., & Fitri, A. (2021). Mobile learning with Android to teach engineering drawing. *Jurnal Pendidikan Teknik Mesin*, *8*(2), 100–108. https://doi.org/10.21831/jptm.v8i2.41657

Suryani, H., Imayanti, I., & Yahya, M. (2018). Effectiveness of clothing pattern making training with CAD-based system. *Proceedings of APTEKINDO 2018.*, *5*(3), 1–10. https://doi.org/10.2991/aptekindo-18.2018.68

Syafrina, I., & Nelmira, W. (2019). Pengembangan Bahan Ajar Pembuatan Sulaman Timbul Pada Mata Kuliah Sulaman Universitas Negeri Padang. *Gorga : Jurnal Seni Rupa*, *8*(1), 105. https://doi.org/10.24114/gr.v8i1.12850

Winarto, H., & Said, W. (2021a). Android-based learning media improve teachers' pedagogical aspects. *Jurnal Edukasi Dan Teknologi*, *8*(2), 112–120. https://doi.org/10.21009/jeter.082.06

Winarto, H., & Said, W. (2021b). Android application to improve vocational teachers' pedagogy. *EAI Conf. Proceedings*, *3*(2), 45–53. https://doi.org/10.4108/eai.11-10-2021.2319599

Wulandari, D. M. F. (2022). Android-based educational games for science materials. *JPPIPA*, *7*(2), 72–80. https://doi.org/10.26740/jppipa.v7n2.p72-80

Yunita, S., & Prasetyo, T. (2023). Interactive CAD learning with Java-based Android. *Jurnal Teknologi Informasi Dan Komputer*, *10*(1), 25–32. https://doi.org/10.24843/JTIKOM.2023.v10.i01.p 04

Zhang, B., & Zhou, R. (2021). Multimedia-based computer-aided ceramic design. *Computer-Aided Design and Applications*, *18*(S4), 49–60. https://doi.org/10.14733/CADAPS.2021.S4.49-60