Vol 43, No 1 (2026): April 2026

Jurnal Penelitian Pendidikan
https://journal.unnes.ac.id/journals/JPP

The Relationship Between Learning Outcomes in the Basic Pattern Construction Course and Learning Outcomes in the Computer Pattern Making Course

Nashira Isnandita, Irmayanti*

Universitas Negeri Semarang, Indonesia

*Corresponding Author: irmayanti@mail.unnes.ac.id

Abstract
Digital transformation in the fashion industry has accelerated the use of Computer-Aided Design (CAD) technology in garment pattern-making processes. This development requires fashion education students to master both manual and digital technical skills. This study aims to analyze the relationship between learning outcomes in the basic pattern construction course and students' learning outcomes in the computer pattern making course. This study employed a quantitative approach with an ex post facto research design. The study population consisted of 81 students from the Fashion Education Study Program, Universitas Negeri Semarang, class of 2023. The sampling technique used was total sampling, so that all members of the population were included as research participants. Data analysis was carried out using descriptive statistical analysis, normality test, homogeneity test, and Spearman rank correlation analysis with the assistance of IBM SPSS Statistics version 26. The results showed that the correlation coefficient between students' learning outcomes in the basic fashion pattern construction course and computer pattern making was 0.210 with a significance value of 0.060 ($\rho > 0.05$). These findings indicate that a high level of mastery of manual pattern-making skills does not always correspond to better learning outcomes in computer-based digital pattern-making courses. Therefore, more integrative learning strategies are needed to bridge the conceptual and procedural gap between manual pattern construction and its application in CAD-based digital pattern systems.

Keywords: fashion pattern construction, digital pattern, computer pattern making, learning outcomes, CAD

INTRODUCTION

The global fashion industry has undergone significant transformation in line with the rapid development of digital technology, particularly in the design and production stages of fashion products (Niinimäki, K., 2020). This digitalization of the industry has encouraged the use of various design software applications, such as Computer-Aided Design (CAD), which enable pattern making and design development to be carried out digitally with a high degree of precision (Kulsum, 2020). Digital technology not only provides flexibility in exploring designs without the limitations of physical media, but also creates new standards in fashion product visualization and development through the integration of digital design systems and pattern simulation (Wang, 2018)

For example, the use of CLO3D software has been shown to accurately visualize digital prototypes through simulation features that can detect pattern errors in real time, thereby minimizing the need for physical sample production and reducing material waste (Renaningtyas et al., 2024). Other studies have also shown that this technology can accelerate the product development cycle because the three-dimensional visualization results are highly similar to the actual product, thus facilitating decision-making in the production chain (Hartanto & Wiryanto, 2020).

As the use of digital technology in the fashion industry increases, mastery of CAD-based design technology and virtual prototyping has become an important competency for professionals in this field (Jin et al., 2023). The modern fashion industry requires human resources capable of integrating design creativity with technology-based technical skills to improve time efficiency and production cost efficiency (Casciani et al., 2022). In theory, pattern digitalization allows designers to test product designs quickly and accurately while minimizing material waste (Fitrihana, 2023). In line with this, (Yuniarti et al., 2023) emphasized that CAD systems have the advantage of producing more accurate patterns than manual methods, which indirectly supports the concept of sustainability in the fashion industry through resource optimization.

In responding to these industry needs, higher education institutions have an important role in preparing human resources who are competent and adaptable to the development of fashion industry technology (Bedor et al., 2025). Fashion Education Study Programs in higher education not only emphasize mastery of fashion design concepts in theoretical terms, but also the development of technical skills relevant to industrial practice (Petrak et al., 2021). Students, as prospective professionals in the fashion field, are expected to understand all stages of the garment production process, from design planning and pattern construction to garment finishing (Jin et al., 2023).

One of the basic competencies that students must master is basic fashion pattern construction. A pattern is a body-form template created based on the wearer's body measurements and used as a guide in the garment-making process (Irmayanti, 2017). This basic competency can be learned through the basic fashion pattern construction course. Based on the course learning design, there are several learning outcomes that must be achieved, including: a) drafting the basic bodice pattern for women, b) drafting the basic skirt pattern, c) drafting the basic sleeve pattern, d) drafting the basic trouser pattern, and e) pattern alteration of women's garments according to design requirements. This is in line with the study conducted by (Yazel Aze et al., 2025) regarding the integration of CAD training to improve digital technology competence for educators and students. The study emphasized that the use of software in pattern making can improve pattern accuracy and consistency by up to 30% compared with manual methods, thereby minimizing early-stage production errors. This integration becomes more optimal through the application of specialized technologies such as Richpeace CAD and CLO3D. (Lestari et al., 2025) also showed that the synergy between precise 2D pattern construction and 3D visualization can significantly accelerate the garment prototyping process.

However, the implementation of computer-based pattern-making learning in the educational context does not always run optimally. Based on observations and interviews conducted with students of the UNNES Fashion Education Study Program, class of 2023, regarding the difficulties they experienced after taking the computer pattern making course, most students felt that they had not been able to operate the software correctly in accordance with the teaching materials provided. This is because the learning design of the computer pattern making course includes several learning outcomes that must be completed, including: (a) introduction to the CAD software interface, (b) digital basic pattern making, (c) pattern grading process, and (d) digital pattern marker arrangement.

This indicates that although students have gained sufficient understanding and skills related to the workflow of manual basic pattern construction through the Basic Fashion Pattern Construction course, in practice some students still have difficulty understanding the workflow of digital pattern making using computer-based software. These difficulties are evident in several important stages, such as entering body measurements, drawing curved pattern lines, performing pattern grading, and arranging digital pattern markers. This condition shows a gap between the learning outcomes of the Computer Pattern Making course according to the university curriculum and the student learning outcomes after completing the course, which have not been optimal, as well as the possibility that student learning outcomes in the basic fashion pattern construction course are not always related to learning outcomes in the computer pattern making course.

Learning outcomes reflect the extent to which students are able to understand the material, master skills, and apply the knowledge obtained during the learning process (Handayani et al., 2025). Therefore, learning outcomes are often used as a benchmark for the success of the learning process (Amalia & Irmayanti, 2026). This also applies to practical learning such as basic pattern construction and computer-based pattern making.

In the educational context, the study conducted by (Sayem, 2022) explains that fashion digitalization has introduced various technologies such as CAD, digital prototypes, and virtual garment simulation, which have not only changed the design and production process but also influenced the fashion design teaching methods used in higher education. In line with this, the study by (Papahristou & Zolota Tatsi, 2024) shows that the integration of 3D virtual design tools in fashion education can improve student creativity, spatial visualization ability, and technical competence while preparing them to face the demands of the modern garment industry. The results of that study also emphasize that students who receive digital garment simulation training have better analytical and problem-solving abilities in the design process. Another study conducted by (Hastuti et al., 2025) also states that the development of CAD-based learning media in digital pattern-making courses can help students understand the use of pattern design software more effectively. The use of technology-based learning media has been proven to improve students' understanding of the digital pattern-making process and support the development of students' technical competencies in computer-based pattern learning.

However, most previous studies have focused more on the integration of digital technology in fashion design education and its impact on digital competence or student creativity. Studies that specifically examine the relationship between basic pattern-making and manual pattern alteration skills and student learning outcomes in computer-based pattern courses are still limited. Therefore, understanding this relationship is important because pattern-making and manual pattern alteration skills are basic competencies in garment construction that have the potential to affect students' ability to adapt to the digital pattern-making systems used in modern fashion education. Accordingly, this study aims to analyze the relationship between basic pattern-making and manual pattern alteration skills and student learning outcomes in creating basic patterns and digital pattern alterations in the computer pattern making course.

METHOD

Research Design

This study aims to determine the relationship between basic pattern-making skills and pattern alteration skills and student learning outcomes in the computer pattern making course. This study is classified as ex post facto research with a quantitative approach. Ex post facto research is conducted without manipulating the independent variable because the variable has already occurred before the study is carried out.

Participants

The population in this study consisted of 81 students from the Fashion Education Study Program at Universitas Negeri Semarang, class of 2023, who had completed the Basic Pattern Construction and Computer Pattern Making courses. The sampling technique used in this study was total sampling, meaning that all members of the population were included as research samples.

This technique is generally used when the population size is relatively small, allowing researchers to examine the entire population without selecting only a portion of the subjects as the sample. According to (Cohen et al., 2017), using all members of the population in a study can provide a more comprehensive picture of the research subjects and reduce sampling bias, especially when the entire population can be reached.

Data Collection Techniques

This study consisted of independent and dependent variables. The independent variable (x) was the learning outcome score in the basic fashion pattern construction course, whereas the dependent variable (y) was the student learning outcome score in the computer pattern making course. The type of data used in this study was secondary data.

Secondary data analysis refers to the use of previously collected data to answer new research questions without directly collecting primary data (Kelly et al., 2024). The data used in this study consisted of student grade documentation from the basic fashion pattern construction course and the computer pattern making course.

Data Analysis Techniques

The data obtained were analyzed using descriptive statistical analysis to provide a general overview of the characteristics of the research data, including the minimum value, maximum value, mean, and standard deviation of each variable. Descriptive statistical analysis is used to summarize and describe collected data so that the condition of the research variables can be systematically illustrated before further analysis is conducted (Mishra et al., 2018).

Next, to determine the relationship between learning outcomes in the basic fashion pattern construction course and student learning outcomes in the computer pattern making course, a correlation test was performed with the assistance of IBM SPSS Statistics version 26. Correlation analysis is used to measure the strength and direction of the relationship between variables in a study (Schober & Schwarte, 2018). However, before hypothesis testing, prerequisite tests were required, namely a homogeneity test to determine whether the research data were homogeneous and a normality test to determine whether the data were normally distributed, thereby enabling the selection of the appropriate statistical analysis technique (Kim, 2013).

RESULTS AND DISCUSSION

Table 1. Descriptive Statistics

Descriptive Statistics						
	N	Range	Min.	Max.	Mean	Std. Dev.
Learning Outcomes in the Basic Pattern Construction Course	81	11.00	77.00	88.00	84.06	2.46
Learning Outcomes in the Computer Pattern Making Course	81	33.00	57.00	90.00	82.38	6.90
Valid N (listwise)	81					

Source: Personal research data

Based on Table 1, the results of descriptive statistical analysis of 81 respondents show that the learning outcomes variable for the fashion pattern construction course had a minimum value of 77 and a maximum value of 88, with a range of 11. The mean score of 84.06 indicates that, in general, students had relatively similar levels of understanding and skill in basic pattern making and pattern alteration. In addition, a standard deviation of 2.46 indicates that the data variation was relatively small, suggesting that the students' skill levels were relatively homogeneous.

Meanwhile, for the learning outcomes variable in the computer pattern making course, the minimum score obtained was 57 and the maximum score was 90, with a range of 33. The mean score of 82.38 indicates that, in general, student learning outcomes in this course reflected a relatively good level of understanding and skill in digital pattern making; however, the gap between the minimum and maximum scores was quite large, indicating substantial differences in students' skills in mastering the technology.

Furthermore, the standard deviation of 6.90 can be considered heterogeneous data. This means that the variation in student learning outcomes was relatively high, with some students obtaining high scores while others received low scores. Thus, although manual pattern-making skills tended to be good and relatively consistent, student learning outcomes in the computer pattern making course, or their ability in computer-based pattern-making learning, showed considerable differences among respondents.

Table 2. Normality Test

Tests of Normality						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Learning Outcomes in the Basic Pattern Construction Course	.206	81	.000	.915	81	.000

Learning Outcomes in the Computer Pattern Making Course	.219	81	.000	.732	81	.000

Source: Personal research data

Based on Table 2, the results of the normality test using the Kolmogorov-Smirnov and Shapiro-Wilk methods show that the fashion pattern construction learning outcomes variable had a significance value of 0.000 in both tests with a sample size of 81 respondents. The obtained significance value is smaller than 0.05, indicating that the data for the fashion pattern construction learning outcomes variable are not normally distributed, so a non-parametric statistical analysis technique is required in the subsequent analysis stage.

A similar result was also found for the learning outcomes variable in the computer pattern making course, where the significance values in the Kolmogorov-Smirnov and Shapiro-Wilk tests were also 0.000 with a sample size of 81 respondents. A significance value below 0.05 indicates that the learning outcomes data do not meet the normality assumption and are therefore not normally distributed. Accordingly, the analysis of the relationship between student learning outcomes in the fashion pattern construction course and the computer pattern making course in this study was continued using the non-parametric Spearman Rank correlation test, which is more suitable for non-normally distributed data.

Table 3. Homogeneity Test (Levene's Test)

		Levene Stat.	df1	df2	Sig.
Learning Outcomes in the Basic Pattern Construction Course	Based on Mean	4.012	1	79	.049
Learning Outcomes in the Computer Pattern Making Course	Based on Mean	2.991	1	79	.122

Source: Personal research data

Based on Table 3, the test of homogeneity of variances using Levene's Test shows that the learning outcomes variable for the basic fashion pattern construction course has a significance value of 0.049. This value is smaller than the significance level of 0.05 ($\rho < 0.05$), so it can be concluded that the data variance in this variable is not homogeneous. This indicates a significant difference in variance between data groups in the fashion pattern construction learning outcomes variable.

Meanwhile, for the computer pattern making learning outcomes variable, a significance value of 0.122 was obtained. This value is greater than 0.05 ($\rho > 0.05$), so it can be concluded that the data variance in this variable is homogeneous. Thus, there is no significant difference in variance between groups in the computer pattern making learning outcomes variable.

Overall, the homogeneity test results show that only one variable meets the homogeneity assumption, whereas the other variable does not. In statistical analysis, data are considered to meet the homogeneity assumption when the significance value in Levene's Test is greater than 0.05. Therefore, in the subsequent analysis, the researcher needs to consider the use of an appropriate analytical technique, especially if the variance homogeneity assumption is not met.

Table 4. Correlations Test

Correlations

			Learning Outcomes in the Basic Pattern Construction Course	Learning Outcomes in the Computer Pattern Making Course
Spearman's rho	Learning Outcomes in the Basic Pattern Construction Course	Correlation Coefficient	1.000	.210
		Sig. (2-tailed)	.	.060
		N	81	81
	Learning Outcomes in the Computer Pattern Making Course	Correlation Coefficient	.210	1.000
		Sig. (2-tailed)	.060	.
		N	81	81

Source: Personal research data

Based on Table 4, the results of Spearman's rho correlation test show that the correlation coefficient between learning outcomes in the basic fashion pattern construction course and learning outcomes was 0.210 with 81 student respondents. This correlation coefficient indicates that the relationship between the two variables is positive. However, the correlation coefficient value, which is close to 0, shows that the relationship between the two variables is very weak.

Table 5. Correlation Coefficient Interval

Correlation Coefficient Interval (r_s)	Correlation Level
0.00 - 0.199	Very weak
0.20 - 0.399	Weak
0.40 - 0.599	Average
0.60 - 0.799	Strong
0.80 - 1.00	Very strong

Source: Sugiyono (2019)

According to the correlation coefficient interpretation guidelines proposed by (Sugiyono, 2019) in his book, a correlation coefficient interval of 0.20-0.399 is categorized as a weak relationship. Therefore, based on this criterion, the correlation coefficient value of 0.020 obtained in this study falls into the very weak relationship category. In addition, the significance value (Sig. 2-tailed) of 0.060, which is greater than 0.05, indicates that the relationship between the two variables is not statistically significant. These findings suggest that, in addition to students' pattern-making skills, there are other unexamined variables that also contribute to learning outcomes in the computer pattern making course.

These findings are also supported by several previous studies showing that the relationship between variables in the learning process does not always have a strong correlation coefficient. The study conducted by (Ulumudin et al., 2021) revealed that the relationship between students' metacognitive development and learning outcomes showed a weak correlation.

The weak relationship between these two variables can be explained by the fundamental differences between the cognitive and procedural processes involved in manual pattern making and computer-based digital pattern making. Manual pattern making involves motor skills, two-dimensional spatial reasoning, and direct understanding of body geometry, whereas digital pattern making using CAD software requires technology literacy, understanding of the software interface, and the ability to translate physical workflows into different digital commands in procedural terms (Papahristou & Zolota Tatsi, 2024). The study by (Badua, 2025) also supports this finding by reporting no significant relationship between the use of certain learning resources and students' academic performance (ρ = 0.068, ρ = 0.303), indicating that learning outcomes are influenced by more complex factors beyond the single variable examined. These findings confirm that relationships between two variables in an educational context are not always linear and strong, but are highly dependent on the learning context and the characteristics of the competencies involved.

This finding is further reinforced by the study of (Hastuti et al., 2025), which shows that students require a learning approach specifically designed to help them understand the use of pattern design software effectively. This indicates that digital competence in pattern making cannot be assumed to form automatically simply through mastery of manual skills, but instead requires directed and structured instructional intervention. Thus, the low relationship between manual pattern-making skills and learning outcomes in computer-based digital pattern making in this study can be understood as a reflection of this competency gap, where the development of digital literacy and familiarity with the CAD software interface are more dominant determinants of successful learning in the computer pattern making course.

CONCLUSION

Based on the results of data analysis involving 81 students from the Fashion Education Study Program at Universitas Negeri Semarang, this study concludes that there is a positive relationship between learning outcomes in the basic fashion pattern construction course and learning outcomes in the computer pattern making course. This finding is indicated by a Spearman rank correlation coefficient value of 0.020 and a significance value of 0.060. These results show that a high level of mastery of manual pattern-making techniques does not automatically guarantee that students will achieve optimal learning outcomes in computer-based digital systems or CAD. Therefore, manual skills cannot be considered the sole predictor of student competence in computer-based digital pattern making, particularly in the use of software such as Richpeace and Optitex. Considering the gap between manual skill scores and learning outcomes in computer-based digital pattern making, educators are advised to evaluate learning strategies by emphasizing synchronization between the logic of manual pattern making and digital pattern systems. Learning should focus not only on software introduction, but also on how physical pattern-construction procedures can be systematically translated into a computer-based digital pattern workflow. For educational institutions, the provision of interactive multimedia-based learning modules is essential to help students overcome technological transition challenges. Meanwhile, future researchers are encouraged to explore other variables that may have a more significant influence on the alignment between manual pattern-making skills and computer-based digital patterns, such as students' digital literacy in pattern making, motivation to master fashion technology, and technical constraints related to the hardware used in practical learning activities.

REFERENCES

Amalia, R., & Irmayanti. (2026). The Relationship Between Basic Pattern Making and Pattern Drafting Skills and Student Learning Outcomes in t he Women ' s Fashion Making Course. *TEKNOBUGA: Jurnal Teknologi Busana Dan Boga*, *14*(1), 117–122.

Badua, C. G. (2025). Teachers' Assessment of Pupils' Utilization of Learning Resources and Its Influence on Academic Performance in Science. *United International Journal for Research & Technology*, *6*(9), 8–17.

Bedor, S. binti A., Kamis, A., & Puad, F. N. binti A. (2025). Fashion education sustainability practices among fashion design students in vocational colleges. *Jurnal Pendidikan Vokasi*, *Vol. 14*(Vol. 14 No. 3 (2024): November). https://doi.org/https://doi.org/10.21831/jpv.v14i3.77869

Casciani, D., Chkanikova, O., & Pal, R. (2022). Exploring the nature of digital transformation in the fashion industry: opportunities for supply chains, business models, and sustainability-oriented innovations. *Sustainability: Science, Practice, and Policy*, *18*(1), 773–795. https://doi.org/10.1080/15487733.2022.2125640

Cohen, L., Manion, L., & Morrison, K. (2017). *Research Methods in Education* (8th editio). Routledge. https://doi.org/https://doi.org/10.4324/9781315456539

Fitrihana, N. (2023). Penerapan Teknologi Virtual 3D Untuk Pengembangan. *Prosiding Pendidikan Teknik Boga Busana.*, *17*(1), 3–7. https://journal.uny.ac.id/index.php/ptbb/article/view/59309

Handayani, T., Mokay, M. M., Sukmayadi, D., A. Fitriani, & Belangi, S. P. (2025). Digital Literacy and Learning Outcomes: Analyzing the Impact of Blended Learning in Higher Education during the Post-Pandemic Era. *International Journal of Educational Research Excellence (IJERE)*, *4*(2), 678–684. https://doi.org/10.55299/ijere.v4i2.1552

Hartanto, S., & Wiryanto, I. E. Y. (2020). Digitalisasi Pola Pakaian melalui Clo3d (Kokreasi bersama LPK Nadya Jaya & Brand Pakaian Lovadova). *Jurnal PkM Pengabdian Kepada Masyarakat*, *3*(3). https://doi.org/10.30998/jurnalpkm.v3i3.5337

Hastuti, M., Ernawati, Nelmira, W., & Giatman, M. (2025). The Development of Android-Based Learning Media for the CAD Pattern Making Course at Universitas Negeri Padang. *Jurnal Penelitian Pendidikan IPA*, *11*(5), 1036–1045. https://doi.org/10.29303/jppipa.v11i5.11226

Irmayanti, I. (2017). Analisis Perbedaan Fitting Factor Antara Pola Sonny Dan Pola Praktis Pada Jas Wanita. *Jurnal MEKOM (Media Komunikasi Pendidikan Kejuruan)*, *4*(2), 92–103. https://doi.org/10.26858/mekom.v4i2.5133

Jin, P., Fan, J., Zheng, R., Chen, Q., Liu, L., Jiang, R., & Zhang, H. (2023). Design and Research of Automatic Garment-Pattern-Generation System Based on Parameterized Design. *Sustainability (Switzerland)* , *15*(2). https://doi.org/10.3390/su15021268

Kelly, M. M., Martin-Peters, T., & Farber, J. S. (2024). Secondary Data Analysis: Using existing data to answer new questions. *Journal of Pediatric Health Care*, *38*(4), 615–618. https://doi.org/10.1016/j.pedhc.2024.03.005

Kim, H.-Y. (2013). Statistical notes for clinical researchers: assessing normal distribution (2) using skewness and kurtosis. *Restorative Dentistry & Endodontics*, *38*(1), 52. https://doi.org/10.5395/rde.2013.38.1.52

Kulsum, U. (2020). Grading Women's Clothing Patterns with the CAD Pattern System to Improve Student Learning Outcomes and Competencies. *Journal of Education Technology*, *4*(2), 187. https://doi.org/10.23887/jet.v4i2.26205

Lestari, V., Simanjorong, M. S. H., Amanda, M., & Suprihanti, S. E. Y. (2025). Penerapan Teknologi Richpeace CAD dan CLO3D dalam Busana Nusantara. *ResearchGate*.

Mishra, P., Pandey, C. M., Singh, U., & Gupta, A. (2018). Scales of measurement and presentation of statistical data. *Annals of Cardiac Anaesthesia*, *21*(4), 419–422. https://doi.org/10.4103/aca.ACA_131_18

Niinimäki, K., et al. (2020). The environmental price of fast fashion. *Nature Reviews Earth & Environment 1.*, *15 April 2020*. https://doi.org/https://doi.org/10.1038/s43017-020-0039-9

Papahristou, E., & Zolota Tatsi, N. (2024). A review of 3D design knowledge and its impact on creativity in fashion design education. *Communications in Development and Assembling of Textile Products*, *5*(2), 266–277. https://doi.org/10.25367/cdatp.2024.5.p266-277

Petrak, S., Naglic, M. M., Rogale, D., & Geršak, J. (2021). Analysis of Polygonal Computer Model Parameters and Influence on Fabric Drape Simulation. *Materials*. https://doi.org/https://doi.org/10.3390/ma14216259

Renaningtyas, L., Tedjokoesoemo, P. E. D., & Krisentia, V. (2024). Pembuatan Pola dan Purwarupa Digital Menggunakan CLO 3D sebagai Langkah Berkelanjutan dalam Industri Fashion. *Nirmana*, *24*(2), 103–113. https://doi.org/10.9744/nirmana.24.2.103-113

Sayem, A. S. M. (2022). Digital fashion innovations for the real world and metaverse. *International Journal of Fashion Design, Technology and Education*, *15*(2), 139–141. https://doi.org/10.1080/17543266.2022.2071139

Schober, P., & Schwarte, L. A. (2018). Correlation coefficients: Appropriate use and interpretation. *Anesthesia and Analgesia*, *126*(5), 1763–1768. https://doi.org/10.1213/ANE.0000000000002864

Sugiyono. (2019). *Statistika Untuk Penelitian*. ALFABETA BANDUNG.

Ulumudin, I., Sofyatiningrum, E., Listiawati, N., & Aisha, A. (2021). Correlational Study on the Relationship Between Students' Metacognition Development and Students' Learning Result. *Proceedings of the International Conference on Educational Assessment and Policy (ICEAP 2020)*, *545*(Iceap 2020), 80–85. https://doi.org/10.2991/assehr.k.210423.068

Wang, L. (2018). An Automatic Pattern Grading Technique in Garment CAD. *Journal of Fiber Bioengineering and Informatics*, *1(4)*, 267–273. https://doi.org/https://doi.org/10.3993/jfbi03200903

Widyastuti, O., Purwanto, A., & Seta, A. K. (2024). he Influence of Integrated Instructional Design of Environmental Education and Teaching Modules in IPAS Learning on Environmental Literacy (Ex Post Facto Method Analysis in the Context of the Merdeka Curriculum). *Eduvest - Journal of Universal Studies*, *4*(6), 5136–5146. https://doi.org/10.59188/eduvest.v4i6.1377

Yazel Aze, H. A., Ernawati, E., Fitria, R., & Zafira, N. (2025). Pemanfaatan Cad Pattern Making Untuk Meningkatkan Akurasi Dan Konsistensi Dalam Pembelajaran Pembuatan Pola. *Edutech*, *24*(3), 1712–1719. https://doi.org/10.17509/e.v24i3.88303

Yuniarti, N., Pramudyarini, R. A., Cheche, A., & Ivana, E. Z. (2023). Penerapan Teknologi Digital Pada Teknik Pecah Pola Fashion Desain. *JSRW (Jurnal Senirupa Warna)*, *11*(2), 121–141. https://doi.org/10.36806/jsrw.v11i2.188