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Zero Waste -Based Fashion Design and Pattern E-Module for Increase Concern Environment

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Abstract

This research aim developing E-modules for Fashion Design and Patterns based on zero waste for increase understanding and concern environment. Background study based on height waste textiles produced in the learning process fashion in vocational schools, as well as Not yet availability of learning media that integrates zero waste principle systematic. The development model used is ADDIE, includes stage analysis, design, development, implementation, and evaluation. Subject study is student class XI SMK Ibu Kartini Semarang, expert materials, media experts, and fashion teachers.

Instruments used covers sheet validation expert, questionnaire practicality, test results learning (pretest-posttest), and sheets observation activity students. Data analyzed using Aiken's, KR-20 reliability test, N-Gain test, homogeneity test, and t-test. Validation results show that the E-module is very suitable used (media = 0.89; material = 0.92). Practicality according to teachers and students is in the very practical category (average 89%). Effectiveness test show improvement significant with an average N-Gain of 0.72 (category high). The t-test results show difference significant between class experiment and control (sig. < 0.05). Observation activity student show improvement in the very good category (86%).

In conclusion, the E-Module zero waste pattern is stated feasible, practical, and effective for increase understanding concepts, skills manufacturing pattern fashion friendly environment, as well as awareness ecological vocational school students. This media recommended for integrated in learning vocational based Independent Curriculum.

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INTRODUCTION

The fashion industry is one of the sector with contribution big to pollution global environment. Production process fashion produce waste cloth approximately 15% of the total materials used (Gam & Banning, 2020). In the environment education vocational, especially SMK Fashion Expertise Program, waste was also created from activity practice manufacturing patterns and sewing. However, learning pattern fashion still dominated approach conventional and not yet integrate principle sustainability such as zero waste pattern.

Zero waste pattern is technique construction pattern fashion that maximizes use material so that no leaving waste piece fabric (Rissanen & McQuillan, 2016). This technique demand creativity and thinking systematic, as well as relevant applied to learning fashion in vocational schools. Some study such as Carrico et al. (2022), Mulyati & Rahayu (2021), and Nisa & Anggraeni (2021) emphasized importance education sustainable in design fashion. However, not yet many learning media that combine digital E-Modules with zero waste principle.

Learning based Project, *Based Learning* is proven effective increase skills vocational and attitudes ecological students. The Independent Curriculum also encourages learning contextual and reinforcement - oriented Profile Pancasila students, one of them style life sustainable. Therefore Therefore, learning media is needed innovative in the form of an interactive E-module that is capable of bridge gap between competence technical and value sustainability in learning pattern fashion.

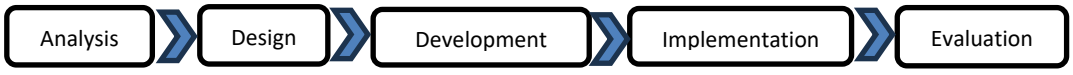
Based on analysis needs at Ibu Kartini Vocational School Semarang, teachers and students not yet once get zero waste pattern learning. Students also have not understand impact waste textiles to environment. Conditions this show the need development of a zero waste E-module that is capable of increase knowledge, skills, and concern environment student.

RESEARCH METHODS

Research Design

This research using development models ADDIE (Analysis, Design, Development, Implementation, and Evaluation), because of this model give channel systematic, structured and achievable development tested in a way empirical. According to Branch (2009), ADDIE is a design model the most adaptive and suitable learning for produce digital media such as E-Modules. In the context of learning vocational, ADDIE selected Because capable ensure achievement competence Work at a time values ecological (sustainable skills).

This research is Research and Development (R&D) which aims for produce learning media products in the form of e- modules and testing feasibility, practicality, and effectiveness as well as activity in learning designs and patterns fashion. The development model used is the ADDIE model, namely something framework Work For design, develop, and evaluate development of e- module learning media. Approach this chosen because ADDIE provides structured and flexible flow, so that suitable For development of learning mediabased technology that requires evaluation and improvement sustainable. Stage flow in the DDIE model can seen in figure 1 below this:



Picture 1. Stages of the ADDIE development model

Development Steps

a) Analysis

Analysis stage is carried out for identify need learning and problems that become base Development of Zero Waste -Based Design and Pattern E-modules in Vocational High Schools. Analysis Results show that learning pattern fashion still cause waste high textiles because not yet availability teaching materials regarding zero waste patterns and their low levels understanding student to impact environment from waste fashion. Students and teachers need learning

media that is interesting, easy to use. studied in a way independent, relevant with curriculum, as well as capable grow awareness ecological. In addition, the analysis concern environment reveal that although student own awareness beginning to danger waste textiles, behavior care environment increase significant after introduced to the concept of zero waste, shown through effort reduce piece remainder, utilize return cloth, and generate creative ideas processing waste. In general overall, stage analysis confirm that development of zero waste based E-modules is urgently needed for support learning pattern sustainable and creation - oriented fashion character care environment.

b) Design

Design stage is stage second in the purposeful ADDIE model designing structure and components of the Zero Waste -Based Design and Pattern E-Module. At the stage this researchers compile framework module, select reference, designing appearance modules, as well as prepare instrument assessment. Compilation the E-module framework is guided by the BSNP (2017) standards, which include part beginning in the form of cover, foreword, CP and ATP, map position modules, as well as table of contents; sections content that contains core material regarding designs and patterns zero waste based; and part the end consisting of from glossary and bibliography. Stage design this ensure module arranged systematic, complete, and appropriate need learning.

c) Development

Stage development, e- modules that have been made then assessed by the validator through instruments that have been prepared and approved by the validator. Validation Eligibility of e- modules carried out by 3 media experts and 3 experts e- module practicality materials and validators done conducted by expert judgment from 10 fashion teachers. The e- module that has been revised in accordance with criticism and suggestions given by the validator, then packed in form Flipbook link and Pdf file.

d) Implementation

Stage *Implementation* is phase Implementation of Design and Pattern Based E-Module *Zero Waste* after stated feasible and practical by experts as well as user. At this stage this module applied to the class experiments, namely student Class XI Fashion at Ibu Kartini Vocational School Semarang, there are 15 students, while Class XI Fashion, SMK N 6 Semarang, 28 students made into class control without treatment. Implementation started with giving *pretest* to second class for know ability beginning related concern environment and understanding *zero waste*. Next, class experiment given treatment in the form of use of E-modules during three meetings in accordance Achievements Learning and Learning Objective Flow, whereas class control still Study without e-module. After treatment, second class given *posttest* with grains same question For measure improvement results learning. In addition, teachers do observation during learning for evaluate activity student in look for information, collaborate, and demonstrate attitude care environment moment practice make pattern fashion. All data from pretest, posttest, and observation used as base for determine effectiveness of the developed e - modules.

e) Evaluation

Stage lastly, namely evaluation, aims For evaluate quality and effectiveness of e- module learning media in a way overall. Evaluation done in two forms, namely evaluation and evaluation summative with assignment based project (PBL). Analyzed data covering results validation expert, response students, as well as score improvement posttest. Based on results evaluation, carried out revision end For perfecting e- module media.

RESULTS AND DISCUSSION

Research result

1. Stage Results Analysis

Analysis need show that student difficulty understand efficiency material when make pattern fashion. The learning used by teachers is still focus on technique construction conventional without consider waste the fabric produced. This is in line with Rissanen's (2019) findings explain that curriculum design fashion traditional seldom enter content sustainability in a way explicit.

The teacher stated that interesting, visual and interactive digital media is really needed for students capable understand zero waste concept.

Conditions this strengthen urgency development of E-modules based on zero waste patterns.

2. Design & Development Phase Results

E- module designed with approach constructivism and learning based project (PjBL). This is in accordance with theory *Vygotsky* emphasized that student build knowledge through activity direct and solution problem. The E-module structure places great emphasis on: (1) visualization pattern, (2) infographics waste cloth, (3) steps manufacturing pattern *zero wast* , and (4) video integration.

Table 1, Validation Results expert

Component	***Score***	***Category***
Validity material	0.92	Very worthy
validity Media	0.89	Very worthy

Subject matter expert assess the E- module as very strong on completeness content, accuracy concept, and suitability curriculum. Media experts assess consistent visual design, navigation easy, and interactivity tall.

3. Implementation Results (Practicality Test)

Practicality test of the developed and assessed E - modules through instrument questionnaire filled out by the teacher as users main learning media. For ensure that instrument practicality the own consistency and truly measure the construct in question, is carried out analysis with use Coefficient Reproducibility (Kr) and Coefficient Scalability (Ks) based on the Guttman scaling model. According to Singarimbun et al (2014: 118-119) if score acquisition Coefficient Reproducibility (Kr) has value > 0.90 is stated fulfil condition.

Calculation results coefficient reproducibility or Kr in study this get Kr score of 0.9. Meanwhile in the scalability test, the coefficient Scalability or Ks acquired Ks score of 0.99, with criteria fulfil condition namely > 0.60 (Nazir, 2005: 343). The teacher assesses the E-module easy used, clear, and improve motivation. Students evaluate the module is very interesting and makes they more understand efficiency material.

4. Effectiveness of E-Modules

a) Pretest–Posttest Results

The results of the pretest and posttest show existence improvement significant value.

Table 2. Pretest–Posttest Results

Pretest Average	**Posttest Average**	**Sig. N-Gain**
72.00	88.89	0.72 (Category Tall)

b) t-Test Results

Based on results of the Normality and Homogeneity tests, then in SPSS it is selected Equal variances not assumed (Welch's t-Test) option. With thus, the t-test remains can used although variance between group No the same, because SPSS is automatic adapt calculation standard error.

The results of the t-test on the results Study class experiments and classes control is as following:

Table 3. Independent Samples Test

		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Standard Error Difference**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
Learning Outcomes (Y)	Equal variances assumed	9.400	0.004	7.840	41	0.000	27.781	3.544	20.625	34.937
	Equal variances not assumed			9.208	40.820	0.000	27.781	3.017	21.687	33.875

Results of the t-test analysis on the results Study student class Experiments and classes Control show that p-value result = 0.00, and because p-value < 0.05 then there is significant difference between results Study class experiments and classes control, namely use of E-modules Enough effective as a learning medium. In addition that there is N-Gain difference between group experimental and contro. The difference in N-Gain was 27.781%.

5. Student Activity Observation Results

Observation results show that activity students in class experiment increase significant until reached 86% with very good category. Students seen more enthusiastic in follow learning, shown through involvement active in do experiment pattern *zero waste*, discuss with friends, modify design, as well as try various alternative fabric layout for minimize waste. In addition, students are also more often look for information addition in a way independent and involved in solution problem related efficiency materials. Improvement this show that E-module capable create atmosphere learn more contextual and applicable. Findings this in line with theory *Prosser* stated that that education vocational must replicate the world of work situation, where efficiency use of materials is skills important in industry fashion. With Thus, the use of E-module no only increase activity Study students, but also sharpen competence vocational and awareness ecological in accordance need sustainable fashion industry.

Discussion

Research result show that *the Zero Waste Pattern* E-module was developed fulfil four indicator quality of learning media that is validity, practicality, effectiveness, and activity students — who are component important in development of educational media based on the ADDIE model. Fourth indicator this required for ensure that the media is worthy applied to learning vocational in vocational schools.

1. Validity (Suitability of Content and Design)

E-module obtain mark validity height that includes aspect eligibility content, language, presentation, and graphics. This show that material module in harmony with zero waste theory, vocational school curriculum, and principle learning demanding vocational harmony between competence theoretical and skills practical (Sudira , 2018). Concept integration sustainability, such as efficiency materials and impacts waste textiles, strengthening role module in support education for sustainable development, as recommended by Hidayati & Kusumaningrum (2020). From the aspect of design instructional, display and flow learning has fulfil rules for effective educational media according to Arsyad (2020), namely simple, clear, and supportive construction knowledge.

2. Practicality (Ease of Implementation and Use)

High practicality score show that module easy used by teachers and interesting for students. Structure material systematic, navigation simple, and visualization step Work make E-modules capable support learning independent and collaborative. Pratama & Sari (2021) emphasized that digital media is practical make things easier student control draft abstract in a way more fast. This is proven in the module this is what provides pattern layout illustration, simulation step work, and example contextual cases. With thus, the module can integrated in learning daily without add teacher's burden, at the same time increase experience Study student.

3. Effectiveness (Improvement Environmental Knowledge, Skills, and Awareness)

Effectiveness proven from high N-Gain value in class experiments, which show improvement significant after use module. Success this influenced by the Project-Based Learning (PjBL) approach, where students given chance for solve real problems related efficiency materials and reduction waste. Wena (2019) explains that PjBL increase creativity and understanding deep because student Study through experience directly. Findings this is also in line with Mayer (2021), who stated that combination text, visuals, and multimedia enhance *retention* and *transfer learning*. In addition to improving cognitive, module this also works grow awareness ecological student to impact waste textiles, according to urgency education vocational green.

4. Activeness Students (Student Engagement and Real Industry Context)

Observation show that activity students in class experiment reached 86% (very good category). Students show involvement active in discussion, pattern layout experiments, analysis efficiency materials, as well as modification design. Height involvement this caused by character interactive and presenting modules problem real as is the case in the industry fashion. This result in line with Prosser's argument states that learning vocational must resemble condition Work in fact, so that competence student relevant with need industry (Allen, 2014). Findings this reinforced by Herlina & Pratiwi (2021), who stated that learning based problem real increase creativity, participation, and awareness environment. With thus, this E-module no only increase cognition, but also building habit professional and attitude care environment.

Table 3. Analysis Table Per Indicator

Indicator	***Findings***	***Empirical Evidence***	***Theoretical Support***
Validity	The module is very valid (value high throughout aspects).	Expert validator materials & media.	Sudira (2018); Arsyad (2020).
Practicality	Easy module usable, engaging, navigable.	Teacher & student practicality scores tall.	Pratama & Sari (2021).
Effectiveness	High N-Gain; increase significant.	Pretest– Posttest class experiment.	Mayer (2021); Wena (2019).
Activity Student	Activity reached 86% (very good).	Observation of 3 meetings.	Allen (2014); Herlina & Pratiwi (2021).

CONCLUSION

This research conclude that E-module *Zero Waste* Pattern developed through the ADDIE model is proven feasible, practical, effective, and capable increase activity student in learning designs and patterns fashion in vocational school. First, the results validation show that module own level high validity in aspects content, language, presentation and graphics, so that can stated in accordance with theory *zero waste*, vocational school curriculum, and principle learning vocational oriented sustainability. Second, from aspect practicality, module assessed easy used by teachers and students because presentation systematic material, attractive visual displays, and flexible for learning independent and collaborative. Third, effectiveness module proven through high N-Gain value, which shows existence improvement significant on knowledge, skills, and awareness environment student after follow learning use module. Improvement This influenced by a combination between approach *Project-Based Learning* and use multimedia elements such as pattern layouts, illustrations step work, and digital simulation. Fourth, the module is also proven increase activity student until reached 86% in class experiments, which show that the media is capable create experience authentic, contextual, and aligned learning with demands industry fashion sustainable. In a overall, E- module *Zero Waste* Pattern does not only increase competence technical participant educate, but also contribute to the formation of attitude care environment, so it is very suitable implemented and recommended for learning vocational in the field fashion.

SUGGESTION

Based on results research and conclusions that have been obtained, then some suggestions that can submitted is as following.

First, for productive teachers in the Fashion expertise program, the Zero Waste Pattern E-module can... made into as alternative learning media that supports implementation draft sustainability in vocational schools. Teachers are advised utilise module this in a way sustainable and integrate it with studio practice, so that student can get experience learn more authentic. Second, for school, results study this can become base in development curriculum and related internal policies implementation learning friendly school environment need provide facility supporters like digital devices and adequate

internet access so that the E-module can utilized optimally.

Third, for researchers next, research this can expanded with develop E-modules on types other clothing (such as outerwear, dresses, or menswear) or use more learning platforms interactive like mobile applications. Further research can also be done add effectiveness test term long for see impact module to formation habit work sustainable in students. In addition, the integration analytic learning (learning analytics) can tested for see pattern interaction student during use module.

Fourth, for maker policies in the field education vocational, results study this can made into references in push Implementation of green skills and sustainable fashion in vocational schools. This in line with need industry modern fashion demands power work that is not only competent in a way technical, but also has awareness ecological and efficient use of materials. Therefore, the development of zero waste- based digital media is necessary considered as part from standard learning vocational in the future.

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