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Integrating Mathematical Patterns in Muslim Fashion Design: a 4D-Based Edupreneurship Innovation

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Abstract

The purpose of this study is to develop an innovation "Mathematical Patterns in Muslim Fashion" an innovation in Muslim clothing design using mathematical patterns and to test its feasibility, practicality, and effectiveness for the development of student edupreneurs. The method used in this study is research and development with 4D model, namely define, design, develop, and disseminate. The subjects of this study were students of Mathematics Education at IAIN Kudus who took the Entrepreneurship course in the even semester of the 2022/2023 academic year. The data collection technique in this study used a questionnaire that included feasibility, namely from expert validation, practicality, namely from student responses, and the effectiveness of using Muslim clothing design innovations using mathematical patterns as student edupreneur development. The results of this study are "Mathematical Patterns in Muslim Fashion" Muslim clothing design innovation using mathematical patterns is feasible with material experts with very good criteria, designer validators with good criteria, and edupreneur expert validators with very good criteria, practicality obtained 96%, and effective with very good criteria used as student edupreneur development.

Keywords: edupreneur, mathematics, muslim fashion

INTRODUCTION

In mathematics education programs, learning is still dominated by theoretical and procedural emphasis, with limited opportunities for students to apply mathematical concepts creatively through real-world products (NCTM, 2014; Cotič, M., Doz, D., Jenko, M. & Žakelj, A., 2024.). As a result, students' mathematical creativity, problem-solving disposition, and entrepreneurial readiness remain underutilized (Kaya-Capocci, S., Pabuccu-Akis, A., & Orhan-Ozteber, N., 2025). While Indonesia, with its large

population and increasingly competitive job market, continues to face challenges in strengthening entrepreneurship among university graduates (BPS, 2022; Rauf, R., Raheni, C., Tovan, M., Setiawan, L., & Rodliyatun, M., 2024). Despite improvements in higher education, Indonesia's entrepreneurship index remains relatively low compared to other developing economies (Hardi, I., Ray, S., Attari, M. U. Q., Ali, N., & Idroes, G. M., 2024)).

At the same time, the Muslim fashion industry has emerged as one of the strongest cultural and economic sectors in Indonesia. The country has consistently ranked among the world's largest Muslim fashion markets and is projected to become a global Muslim fashion hub (Hassan, F. H., et al., 2024). Muslim clothing trends increasingly demand innovative designs that integrate cultural identity, aesthetics, and modern creative elements (Mulyani & Natalliasari, 2020). This development opens opportunities for educational institutions to link mathematics-based creativity with fashion entrepreneurship, especially among mathematics education students who rarely engage in creative product design.

Mathematics itself provides rich potential for innovation through patterns such as the concepts of geometry, symmetry, tessellations, fractals, and transformations widely discussed in mathematics education literature (Boaler, J., 2022; Pepin, B., Biehler, R., & Gueudet, G., 2021). These mathematical structures often appear in cultural artifacts. Ethnomathematics research has shown that traditional houses, woven fabrics, ornaments, and batik motifs contain mathematical concepts including geometric shapes, symmetry, and transformational patterns (Afrianyah, 2012; Supiyati et al., 2019; Sutarto, Ahyansyah, et al., 2021). Studies on local culture, such as the Bagas Godang traditional ornaments (Dewita et al., 2019) and Madurese batik patterns (Zayyadi, 2017), demonstrate that mathematical ideas can be a source of artistic creativity.

However, several gaps remain unresolved in the literature in which no studies have developed Muslim fashion products explicitly designed using mathematical patterns as a medium for student entrepreneurship learning. Research that bridges ethnomathematics, muslim fashion design, and edupreneurship is still scarce, although such integration aligns with culturally responsive and creative mathematics education. This gap presents an important opportunity for mathematics education to expand beyond theoretical instruction. Integrating mathematical creativity with real product development can enhance students' mathematical literacy, design thinking, problem-solving, and entrepreneurial capacity (Anggun, M. S., Fakhruddin, F., Arbarini, M., Subali, B., & Widiarti, N., 2025; Nilimaa, J., 2023; Weng, X., Chiu, T. K., & Tsang, C. C., 2022; Van De Walle, 2008). In the context of entrepreneurship education, edupreneurship emphasizes learning through creativity, risk-taking, product design, and market-oriented thinking (Asriati, 2018; Silangen, 2019; Widayati et al., 2019). Such an approach enables mathematics education students to connect mathematical knowledge with economic empowerment and innovation.

Based on these considerations, this study introduces an innovation entitled "Mathematical Patterns in Muslim Fashion", integrating mathematical concepts into Muslim clothing design as a learning medium for edupreneurship. This responds to the

two following core problems: (1) mathematics education students lack experience applying mathematical concepts in creative product development; and (2) no existing edupreneurship learning model utilizes mathematical patterns as an innovation for Muslim fashion. All in all, the purpose of this study is to design, develop, and evaluate the feasibility, practicality, and effectiveness of Muslim clothing design innovations based on mathematical patterns to enhance students' edupreneur skills.

METHODS

The method used in this study is research and development with the 4D model, namely define, design, develop, and disseminate (Thiagarajan, Si, Semmel, DS, Semmel, 1974). The define stage was conducted to analyze student needs, characteristics, and the potential for integrating mathematical patterns into Muslim fashion design. The design stage focused on developing mathematically inspired Muslim fashion concepts that support the strengthening of students' edupreneurial skills. The develop stage then included expert validation and limited trials, while the disseminate stage involved socialization and utilization of the innovation results as a medium for student edupreneurial development.

The selection of this method aims to produce a product in the form of "Mathematical Patterns in Muslim Fashion", namely an innovation in Muslim clothing design using a mathematical pattern that is feasible, practical, and effective. A limited trial was conducted on 6 IAIN Kudus Mathematics Education students taking the Entrepreneurship course in the even semester of the 2022/2023 academic year, selected using a cluster random sampling method, namely, taken from 3 Entrepreneurship course classes, each with 2 students. The dissemination trial was conducted on 89 IAIN Kudus Mathematics Education students taking the Entrepreneurship course in the even semester of the 2022/2023 academic year. The data collection techniques in the study were a feasibility questionnaire, from expert validation, a practicality questionnaire, from student responses, and a questionnaire on the effectiveness of using Muslim clothing design innovations using mathematical patterns as student edupreneur development.

This study involved validators consisting of material experts, designer validators, and edupreneur experts, with two people each in each area of expertise. The material experts' role was to assess the feasibility and accuracy of the mathematical content used, the designer validators were tasked with evaluating aspects of Muslim fashion design, while edupreneur experts are tasked with evaluating the suitability of innovations with the edupreneur concept, and the potential for developing student entrepreneurship. The assessment instrument used was a questionnaire. The assessment was carried out using a Likert scale with four alternative answers: strongly agree, agree, disagree, and strongly disagree, with a score range of 1–4 for each statement item.

Table 1. Validation Questionnaire Instrument and Number of Statements

Validation Questionnaire Instrument	Number of Statements
Material experts	12
Designer	9
Edupreneur experts	13

Data analysis in this study went through the following stages.

a. Validating the "Muslim fashion mathematics" clothing design, revisions were made based on expert feedback.
b. Feasibility and effectiveness data were obtained from experts and students using a Likert scale as a reference for compiling a questionnaire with Likert scale criteria used with five intervals, consecutively from a score of 1 to 5, which are very poor, poor, fair, good, and very good.
c. Determining the level of feasibility and effectiveness is by changing the existing values according to the ideal assessment criteria with the following formula:

Table 2. Ideal Assessment Criteria

No.	Score Range	Category
1.	$X > M_i + 1{,}8\ Sb_i$	Very Good
2.	$M_i + 0{,}6\ Sb_i < X \leq M_i + 1{,}8\ SB_i$	Good
3.	$M_i - 0{,}6\ Sb_i < X \leq M_i + 0{,}8\ SB_i$	Fair
4.	$M_i - 1{,}8\ Sb_i < X \leq M_i - 0{,}6\ SB_i$	Poor
5.	$X \leq M_i - 1{,}8\ Sb_i$	Very Poor

(Widoyoko, 2009)

Information:

X = Total actual score (empirical)
The highest ideal score = criteria item x highest score
The lowest ideal score = criteria items x lowest score
Mi = ideal mean = ½ x (ideal highest score + ideal lowest score)
SBi = ideal standard deviation = 1/6 x (ideal highest score - ideal lowest score)

Practicality data were obtained from a 20-question student response questionnaire, with a closed-ended questionnaire consisting of positive and negative questions. The student questionnaire used a Guttman scale with only two intervals, namely "YES" and "NO".

Determining the percentage value of practicality. The percentage value of practicality can be calculated using the formula:

$$percentage\ of\ practicality = \frac{\sum observation\ result\ score}{\sum maximum\ score} \times 100\%$$

The innovation of Muslim clothing design using mathematical patterns to develop student edupreneurs is considered practical if it gets a percentage of ≥ 80%.

RESULTS & DISCUSSION

The result of this research and development is the design of Muslim clothes using mathematical patterns and the effectiveness of using "Mathematical Patterns in Muslim

Fashion" Muslim clothing design innovations using mathematical patterns as the development of student edupreneurs.

Validity

Validity shows the level of feasibility of innovation in mathematical-style Muslim fashion design based on the assessment of experts, including material experts, designers, and edupreneur experts. Validity shows the level of feasibility of innovation in mathematical-style Muslim fashion design based on the assessment of experts, including material experts, designers, and edupreneur experts.

The validation of material experts is validated by two material expert validators, namely IAIN Mathematics Tadris lecturers. The results of the recapitulation of the validation of the material expert obtained a score of 43, so the validation in terms of material and the design of Muslim clothes using mathematical patterns is included in the "Very good" category.

Two designer validators carry out designer validation. The average result of the overall designer's assessment obtained a score of 29.5, so the validation of the design of Muslim clothes using mathematical patterns is included in the "Good" category.

The validation of edupreneur experts is validated by two material expert validators, namely IAIN Mathematics Tadris lecturers. The average result of the overall assessment of the subject matter expert obtained a score of 46, so the validation in terms of edupreneurship, and the design of Muslim clothes using mathematical patterns is included in the "Very good" category.

Practicality

The practicality aspect shows the ease of use of the innovation by students as the main users. The data on the results of student assessments is as follows:

Table 3. Student's Response to the Design of Muslim Clothes Using Mathematical Patterns

Assessment Indicators	Average (%)	Information
Purpose	95%	Positive response
Accuracy	100%	Positive response
Technical Quality	95%	Positive response
Practicality	100%	Positive response
Innovation	90%	Positive response
Proactive	95%	Positive response
Average Total (%)	96%	Positive response

Based on the data obtained (Table 3), it can be concluded that the student's response to the design of Muslim clothes using mathematical patterns was positively responded to with an average percentage of 96%.

Effectiveness

The results of the effectiveness analysis reflect the extent to which innovation is able to improve students' entrepreneurial soft skills. The average score of the edupreneur questionnaire of Tadris Mathematics IAIN Kudus students who took the Entrepreneurship course in the even semester of the 2022/2023 academic year was 39.38, meaning that in terms of edupreneurship character, Tadris Mathematics IAIN Kudus students who took

the Entrepreneurship course in the even semester of the 2022/2023 academic year were in the "Very Good" category.

The prototype produced

The design of Muslim clothes using this mathematical pattern is the brand name "Elzigma". In this first production, Elzigma also provided Muslim clothes for men and women, both adults and children. The following is the final motif of Muslim clothes using mathematical patterns:

Figure 2. Muslim Clothing Motifs Using Mathematical Patterns

After the motif is finished and noticed, it is continued with the creation of the shirt design of the ibis paint application. This Muslim clothing design consists of clothing designs for adult women, adult men, girls, and boys. The following is a shirt design for adult women.

Figure 3. Muslim Shirt Design Using Mathematical Patterns

Project-based learning provides students with the opportunity to explore their full knowledge, thus increasing motivation and enthusiasm for learning (Awab et al., 2021). However, research (Rusmana, 2020) shows that students' entrepreneurial competencies are still relatively low, with an average score of only 3. Therefore, efforts to develop

entrepreneurial competencies integrated into the learning process are necessary. In this context, understanding student characteristics is crucial because the success of the learning process depends heavily on the alignment between student needs and the learning strategies implemented (Pudji & Bagus, 2021).

Characteristics that must be possessed to become an entrepreneurial student according to Pelipa and Anna Marganingsih (2017), namely:

1. Emotionally intelligent, able to manage emotions.
2. Have a strong determination and intention not to give up easily.
3. Discipline, including completing tasks on time.
4. Have a strong desire to overcome obstacles and obstacles.
5. Believing in one's abilities means controling anxiety and doubt in doing business.
6. Dare to take risks and make wise decisions.
7. Never give up.
8. Honestly, to gain the trust of business partners.
9. Creative and innovative, the products created are different from the existing ones.
10. Capable in managing financial administration.
11. Sincere and grateful for what has been obtained.

This development research resulted in the design of Muslim clothes using this mathematical pattern. The fashion products designed are quality and innovative related to mathematics and Islam. The design we produced is also very feasible to compete with similar products. The purpose of Muslim clothes using this mathematical pattern is so that people no longer think math is complicated because mathematical formulas are very related to everyday life, especially for teenagers. Good images, graphs, diagrams, and other forms of representation are needed to communicate something. Thus, problems initially looking difficult and complicated can be solved more easily (Sabirin, 2014).

The design of Muslim clothes using this mathematical pattern that keep up with the times and adjust to the market's desires provides quality and innovative fashion products related to mathematics. This is in line with Setyawati's research, students' interest in entrepreneurship is in goods production. (Setyawati, 2020).

For students, Muslim clothes using this mathematical pattern provides an opportunity to hone the entrepreneurial spirit, improve soft skills by being directly involved in the world of work, increase the courage to start a business, get capital support and integrated assistance, petrify the mindset of the younger generation from an early age, be able to become a pioneer of development and reduce unemployment in Indonesia. To be able to channel creativity and innovation themselves, students need to get an introduction to entrepreneurial opportunities from entrepreneurship education lectures (Rahmawati & Nugrahani, 2019)

Ethnomathematics is used by many people ranging from cultural groups, students, the public, to professionals (Nusantara & Rahardjo, 2017; Widada et al., 2019; Muhammad, Marsigit, &Soeharto, 2019). Muslim Fashion Mathematics that researchers

have developed has advantages and disadvantages. The advantages of this product include: (1) It can foster student enthusiasm in learning (2) Collaborate in compiling products so that a positive sense of competition arises in learning (3) It can cause a pattern of interaction of student activities during learning so that it affects the learning process (4) It can improve student entrepreneurial competence, including encouraging the spirit of competition, never giving up, and daring to try. The disadvantages of this product include: (1) The use of this product requires much time to explain to students (2) This product cannot develop all learning materials (3) Lack of understanding of development by students can cause commotion.

The results of this study indicate that the innovation of Muslim fashion design through the application of mathematical patterns is not only feasible, practical, and effective for use in learning, but is also able to contribute significantly to developing students' edupreneur skills, so that it can be used as an innovative alternative in supporting creative and contextual entrepreneurship learning in higher education.

CONCLUSION

The results of this study are "Mathematical Patterns in Muslim Fashion" Muslim clothing design innovation using mathematical patterns that are feasible with material experts with a very good category, designer validators with a good category, and edupreneur expert validators with a very good category. Practicality obtained a score of 96% with a practical category. Effective with very good category used to support student edupreneurship development. Based on the advantages that have been explained, of course, it needs to be maintained and improved. Based on the shortcomings that the researcher has explained, the researcher hopes that the products that will be developed further can be developed again into more valuable products for the future. This research demonstrates that integrating mathematical patterns into Muslim fashion design is an effective, innovative approach to developing students' edupreneurial skills. Furthermore, this research opens up opportunities to utilize culturally and religiously based products as a vehicle for strengthening entrepreneurship in higher education settings. Educators are advised to implement innovative mathematically inspired Muslim fashion designs in entrepreneurship learning. Future research can develop variations in mathematical patterns and expand the research subjects to test the sustainability of the impact on developing students' edupreneurial skills.

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