

# Evaluating User Experience in the Ambatig Mobile Application for 2D Motif Generation Based on Frieze and Crystallographic Patterns

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**Abstract.** This study evaluated the user experience (UX) of Ambatig, a mobile application to create 2D motifs based on frieze and crystallography patterns, using the User Experience Questionnaire (UEQ). Scores were transformed to  $-3...+3$  and analyzed across three aspects and six scales. The results showed Attractiveness 2.10; Pragmatic Quality 1.97; Hedonic Quality 2.07. At the scale level, Stimulation was the highest ( $\approx 2.40$ ), followed by Attractiveness (2.10); Perspicuity (2.03) and Dependability (1.97) were positive; Efficiency was the lowest in the pragmatic cluster (1.92); Novelty was positive but the lowest (1.74). The confidence intervals for all scales were above zero, and the reliability was adequate. The UEQ benchmark placed all scales in the 'Excellent' category (top 10%). This research yielded suggestions for simplifying repetitive steps for efficiency, aligning key terms/icons for clarity, and increasing novelty while maintaining connectivity between features.

**Keywords:** Ambatig, User Experience, UEQ, symmetry, batik motifs, mobile application.

## 1 Introduction

Mobile applications for pattern creation are only useful if they are easy to learn, efficient, reliable, and provide a pleasant experience for users. Research on human-computer interaction showed that perceptions of comfort and interface aesthetics are closely related to perceptions of usability so that the quality of the user experience influences the acceptance and continued use of a system [1], [2].

In this context, Ambatig was developed to facilitate the development of two-dimensional motifs based on frieze and crystallographic patterns. However, the accuracy of the pattern logic is not enough; clarity of terminology, easy-to-follow workflows, ease of feature management, and stability of interactions need to be ensured from the outset. The principles of human-centered design (HCD) place user needs, context, and objectives at the core of design decision-making

throughout the development cycle, as recommended in ISO 9241-210 standards, ensuring that interaction quality, not merely functionality, is the focus of engineering and evaluation. [3]

To assess the quality of user experience in a concise yet comprehensive manner, this study applied the User Experience Questionnaire (UEQ). The research instrument covered six aspects: Attractiveness (overall appeal), Perspicuity (ease of learning/clarity), Efficiency (speed and effort), Dependability (sense of control/reliability), Stimulation (engagement/enjoyment), and Novelty (innovation). The assessment was conducted through 26 questions, each presenting two opposing terms, such as clear and confusing, efficient and inefficient, innovative and conventional, with a scale from 1 to 7, ranging from very negative to very positive [4], [5].

In addition, UEQ provides cross-product/context benchmarks that help position application scores in interpretive categories (e.g., below average, average, good, excellent). This ease of interpretation enables development teams to map interface improvement priorities and assess the impact of design iterations from one version to the next [6].

In Indonesia, studies have demonstrated the usefulness of UEQ in various Indonesian language applications. From the field of education to public services, the findings show a relatively consistent pattern: pragmatic dimensions such as Perspicuity, Efficiency, and Dependability tend to have positive values, while Novelty and Stimulation often emerge as areas requiring improvement through interface innovation and enhanced interaction; examples of such applications include regional script keyboard applications (reporting scores per scale along with terminology recommendations and workflow), academic information systems (UEQ combined with heuristic walkthroughs for navigation structure improvements), integrated learning systems (mapping strengths in Attractiveness/Perspicuity and notes on Dependability/Novelty), virtual campus tours (emphasis on enhancing Novelty), regional public complaint channels (UEQ used to guide measurable interface iterations), and digital wallet applications (strengths in pragmatic aspects with a push for feature updates to ensure competitive Novelty); these findings collectively reinforce the relevance of UEQ for Indonesian-language interfaces and local user characteristics, while also providing empirical benchmarks for interpreting measurement results in this study [7], [8], [9], [10], [11], [12], [13].

Therefore, this study focuses on evaluating the Ambatig user experience using the UEQ after participants completed representative tasks. The objectives of this study were: (1) to map the quality of experience across the six UEQ scales, (2) to identify areas of the interface that need improvement based on the quantitative UEQ findings and supporting qualitative feedback, and (3) to develop recommendations for improvement that maintain the visual direction of the motif while increasing ease of use, efficiency, reliability, engagement, and a sense of novelty for users. The assessment was conducted immediately after the completion of the series of tasks to ensure that the collected responses reflect the actual experience. Where when filling out the questionnaire, users were given a questionnaire in Indonesian according to the current development of Ambatig. Then the results of user answers were interpreted according to the context of use, so that each finding could be linked to concrete design decisions. To ensure traceability, procedures, instruments, and interpretation criteria were explicitly outlined, including checks for internal consistency, standard deviation, and confidence intervals, as well as the development of action items that could be directly applied to subsequent interface revisions based on field user findings.

## 2 User Experience Questionnaire (UEQ)

UEQ is a quick questionnaire to assess user experience through 26 items in the form of a 7-point semantic differential scale. Each item provides respondents with two words with opposite meanings, and they choose a position between 1 and 7 on the scale.



Fig. 1. Sample of questionnaire items [14].

UEQ items are grouped into six scales: Attractiveness, Clarity, Efficiency, Reliability, Stimulation, and Novelty. This division balances two assessment areas: pragmatic aspects related to task completion (Clarity, Efficiency, Reliability), and hedonistic aspects capturing emotions and aesthetics (Stimulation, Novelty). Attractiveness serves as a general valence, summarizing the user's impressions [4].

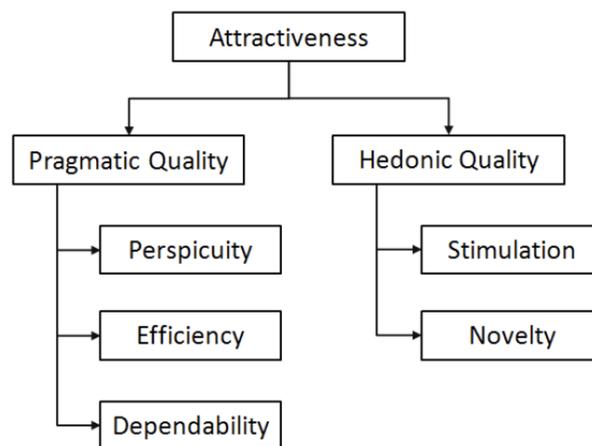


Fig. 2. Assumed scale structure of the UEQ [6].

Appeal captures the 'tone' of the experience—whether the application is liked or feels intrusive. Clarity assesses the ease with which the interface is understood and learned by new users. Efficiency captures the speed of interaction, the conciseness of steps, and the regularity of elements when tasks are performed. Reliability relates to a sense of security and control, including the predictability of system responses and its support for users. Stimulation records the level of motivation and emotional engagement during interaction. Novelty assesses the impression of creativity and modernity of the design compared to familiar alternatives, which often determines long-term appeal.

These six scales provide a comprehensive yet concise overview of the user experience, assessing whether the product is easy to understand, efficient, reliable, enjoyable, and novel. Each scale is interdependent. Increased clarity, for example, often impacts the sense of control and perceived ease of interaction, while a proportionate element of novelty can maintain engagement without disrupting workflow. The UEQ is suitable for use in the early stages of development to map strengths and areas of concern before a more in-depth evaluation. In various contexts and

languages, this instrument helps translate user impressions into systematic and easily communicated directions for improvement. Thus, the UEQ can be used to assess initial acceptance and prioritize evaluation in subsequent development.

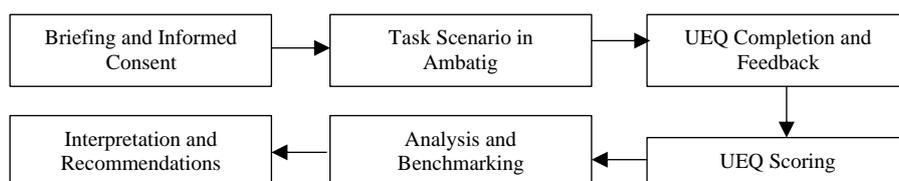
Table 1 presents pairs of terms in negative → positive order to maintain consistency in the direction of assessment; terms on the assessment scale; respondents choose one of seven positions between the two extremes. Each choice from 1 to 7 was then transformed into a range from -3 to +3, where positive values indicated a better impression; the average for each scale was calculated from the corresponding items, ensuring that items with opposite orientations have been aligned in direction. In practice, the common interpretation thresholds are:  $> +0.8$  = positive impression,  $-0.8 \dots +0.8$  = neutral, and  $< -0.8$  = negative. For cross-product comparisons, scores can be mapped to the UEQ benchmark (categories: Below Average, Above Average, Good, Excellent) to position findings and set priorities for interface improvements; official guidelines also recommend reporting confidence intervals for more robust interpretation. References for item definitions, scales, scoring rules, and benchmarks follow the original UEQ publication and UEQ Handbook [4], [5], [6].

**Table 1.** UEQ scale and its item pairs [4].

UEQ Scale	UEQ Item Pairs
Attractiveness	annoying/enjoyable
Attractiveness	unattractive/attractive
Attractiveness	unfriendly /friendly
Attractiveness	Bad/ good
Attractiveness	unlikable/pleasing
Attractiveness	unpleasant/pleasant
Dependability	does not meet expectations/meet expectations
Dependability	obstructive/supportive
Dependability	not secure/secure
Dependability	unpredictable/predictable
Efficiency	slow/fast
Efficiency	impractical/practical
Efficiency	inefficient/efficient
Efficiency	cluttered/organized
Novelty	conservative/innovative
Novelty	dull/creative
Novelty	conventional/inventive
Novelty	usual/leading edge
Perspicuity	confusing/clear
Perspicuity	complicated/easy
Perspicuity	difficult to learn/easy to learn
Perspicuity	not understandable/understandable
Stimulation	boring/exciting
Stimulation	demotivating/motivating
Stimulation	not interesting/interesting
Stimulation	inferior/valuable

### 3 Method

This section describes the research design, participant characteristics, instruments, data collection procedures, and scoring and analysis techniques to evaluate the user experience of the Ambatig application using the User Experience Questionnaire (UEQ). The procedures of this research are:



**Fig. 3.** Research Procedures.

1. **Briefing and Informed Consent.** Before the session began, the researcher explained the objective of the study, the scope of the activity, and the estimated duration ( $\pm 25$ –35 minutes), accompanied by a description of data confidentiality and participant rights, including the freedom to withdraw from participation at any time without consequences. After understanding this information, participants signed an informed consent form. Initial characteristics (device type, screen size, and experience using similar applications) were documented as context for analysis.
2. **Task Scenario in Ambatig.** Participants performed a series of tasks that represented the actual usage flow: T1 selected the canvas feature; T2 drew any motif; T3 selected a symmetry pattern (frieze/crystallography); T3 adjusted the motif parameters; T3 reviewed the preview and made adjustments if necessary; T4 saved or exported the results. Throughout the session, the moderator did not provide direct solutions to ensure that the recorded UX experience was authentic and reflected an independent experience.
3. **UEQ Completion and Feedback.** After completing the task, participants filled out the UEQ (26 items, 6 scales, 7 response levels) to capture their immediate impressions of their interaction with Ambatig. Instructions were brief and uniform, and participants were asked not to discuss the task while completing the questionnaire so that their responses would remain independent. Two open-ended questions recorded the most helpful and most confusing aspects, so that the UEQ scores could be linked to specific and operational interface issues.
4. **UEQ Scoring.** Each response on a scale of 1–7 was transformed to a range of –3 to +3. Items with reverse orientation were aligned first so that higher values always indicated better experiences. The score per scale was obtained from the average of the items on the relevant scale (Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation, Novelty).
5. **Analysis and Benchmarking.** Mean, SD, and 95% CI were reported for each scale; Cronbach's  $\alpha$  was used to assess internal reliability (target  $\geq 0.70$ ). Scores were then

mapped to the UEQ benchmark (Below Average, Above Average, Good, Excellent) to provide cross-product context.

6. **Interpretation and Recommendations.** Quantitative findings were matched with open comments to establish priorities for improvement; examples included naming symmetry class icons, parameter control layout, or exported flow clarity. Recommended internal targets: Perspicuity and Efficiency  $\geq +0.8$ , and no scale with a value  $< -0.2$ .

## 4 Results and Discussion

### 4.1 UEQ Score Transformation

At this stage, UEQ scores that were originally in the range of 1–7 were normalized to a range of –3 to +3. Normalization was performed to centre the values at 0 as a neutral point and to standardize the direction of assessment across all items, so that the results between items and between scales could be compared more clearly. After transformation, the scores were aggregated at the level of the six UEQ scales: Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation, and Novelty to obtain an overall picture of the user experience. This summary of scale values then formed the basis for interpreting the results and prioritizing interface improvements.

### 4.2 Data Cleansing

The initial respondents consisted of 50 batik creators/batik business workers in Medan City. Before analysis, all questionnaire responses were checked and cleaned to ensure completeness, consistency, and data quality. This process was carried out using the UEQ Data Analysis Tool v12. In the Inconsistencies tab, 4 problematic questionnaires were detected with a critical indicator  $> 3$ , including irregular scale filling patterns, a tendency to choose the same value for all items (straightlining), and other inconsistencies. In accordance with the analysis tool's recommendations, the six entries were excluded to maintain the validity and reliability of the findings. As a result, the final data analysed comprised 46 respondents.

### 4.3 Reliability Test

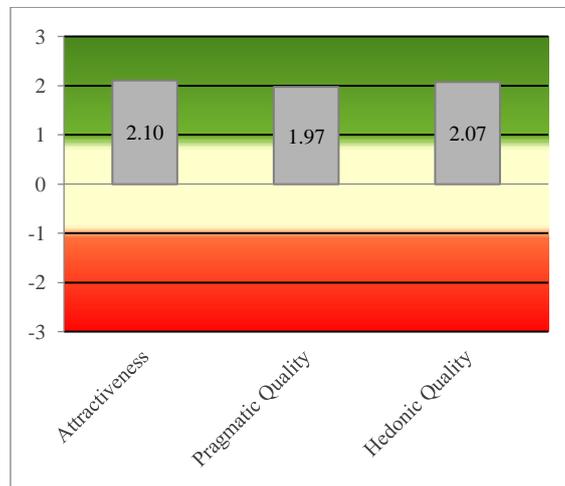
The reliability test showed adequate internal consistency across all UEQ scales, with a practical threshold of Cronbach's  $\alpha \geq 0.70$ . The values obtained were: Attractiveness 0.88 (very good), Perspicuity 0.82 (good), Efficiency 0.78 (good), Dependability 0.77 (fair–good), Stimulation 0.81 (good), and Novelty 0.76 (fair–good); see Table 2. Thus, the entire scale met the reliability criteria and was suitable for interpreting the results and further discussion.

**Table 2.** Reliability Test Results Based on Cronbach's  $\alpha$ .

Scale	Reliability of <i>Cronbach's</i> $\alpha$
Attractiveness	0,88
Perspicuity	0,82
Efficiency	0,78
Dependability	0,77
Stimulation	0,81
Novelty	0,76

#### 4.4 Analysis and Benchmarking

As the method flow, after reliability was fulfilled and data was cleaned, the results were read in stages from the aggregate of three aspects to the sixth scale by linking the findings to the context of Ambatig use. At the aggregate level, the Attractiveness score of 2.10, Pragmatic Quality 1.97 (combining Perspicuity, Efficiency, and Dependability), and Hedonic Quality 2.07 (combining Stimulation and Novelty) indicated a consistently positive experience within the range of  $-3$  to  $+3$ . The balance between pragmatic quality (1.97) and hedonic quality (2.07) indicated that assistance in task completion, clarity of workflow, responsiveness, and a sense of control were achieved without sacrificing elements of sensory appeal, engagement, and emotional appeal. Such a score composition was typically a prerequisite for repeated use, especially in creative applications that required exploration.



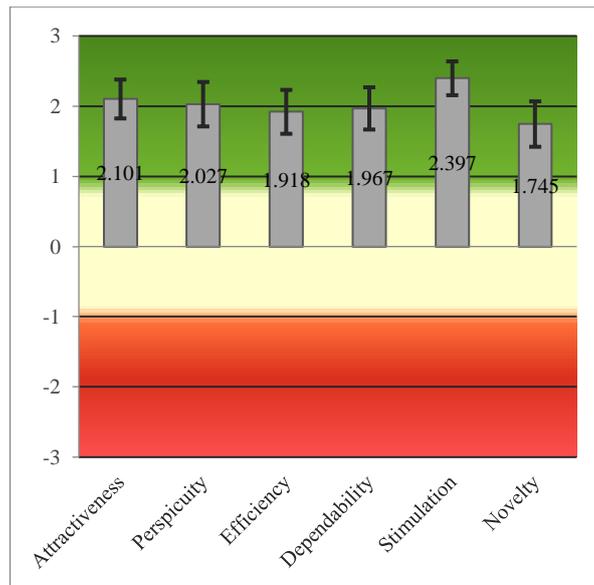
**Fig. 4.** Third mean graph of the UEQ scale.

**Table 3.** Sixth Confidence Interval of the UEQ Scale.

Scale	Confidence intervals ( $p=0.05$ ) per scale					
	Mean	Std. Dev.	N	Confidence	Confidence interval	
Attractiveness	2,101	0,959	46	0,277	1,824	2,379
Perspicuity	2,027	1,096	46	0,317	1,711	2,344
Efficiency	1,918	1,083	46	0,313	1,606	2,231
Dependability	1,967	1,040	46	0,301	1,667	2,268
Stimulation	2,397	0,834	46	0,241	2,156	2,638
Novelty	1,745	1,121	46	0,324	1,421	2,069

When examined by scale ( $N = 46$ ), stimulation ranked highest with a mean of 2.397 (SD 0.834; 95% CI 2.156–2.638). This figure indicates a strong psychological drive to explore: users find the process of trying out different motifs enjoyable. The relatively tight distribution (the smallest

standard deviation among the scales) suggested that the ‘exciting/interesting’ experience was felt fairly evenly across respondents. Attractiveness of 2.101 (SD 0.959; 95% CI 1.824–2.379) confirmed the overall favourable impression; in practice, such initial impressions were often associated with intentions for continued use and acceptance of the product in a creative work environment.



**Fig. 5.** Sixth mean graph of the UEQ scale.

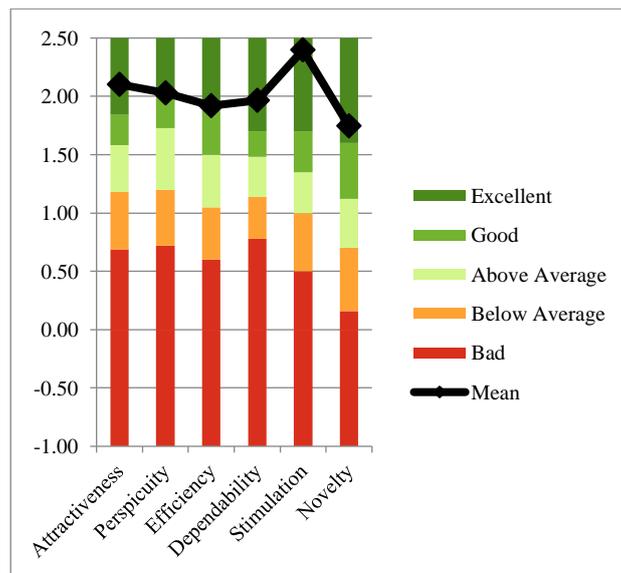
In the pragmatic cluster, Perspicuity 2.027 (SD 1.096; 95% CI 1.711–2.344) and Dependability 1.967 (SD 1.040; 95% CI 1.667–2.268) indicated that the flow and terms of the interface were generally easy to understand, while the behaviour of the system was perceived as consistent and predictable. However, the relatively wide variation in Perspicuity signals heterogeneity in experience: some users might still require additional clarity on key elements, such as the naming of symmetry classes, parameter control labels, or specific icons, especially when first using the application. Efficiency 1.918 (SD 1.083; 95% CI 1.606–2.231) remained within the positive range but was the lowest value in the pragmatic cluster. Such patterns commonly emerged when there were minor friction points in frequently repeated steps, such as when adjusting parameters multiple times or when saving/exporting results on certain device types. Reducing the number of steps, repositioning frequently used controls, and providing easily accessible presets/templates and undo/redo functions had the potential to enhance perceived efficiency without compromising clarity.

In the hedonistic cluster, Novelty 1,745 (SD 1,121; 95% CI 1,421–2,069) still showed positive ratings, but was the lowest among the six scales and had the largest spread. This finding suggests differences in perceptions of novelty across user segments: some users perceive Ambatig’s ideas and design as fresh and creative, while others find the visual experience and features relatively familiar. The recommended interventions are targeted and lightweight, including regular curation of new motif examples, variations in pre-made palettes, subtle micro-interactions

during preview/exploration, and educational empty states, to enhance the sense of discovery without adding cognitive load or disrupting task flow.

The strength of inference was supported by the lower limit of the entire confidence interval, which remained well above zero (lowest 1.421 in Novelty), making it unlikely that the actual value was close to the neutral zone. This aligns the adequate to very good reliability test results (Cronbach’s  $\alpha$  0.76–0.88) across all scales, so the average per scale can be used with confidence to conclude the quality of the experience and set priorities for improvement.

In conclusion, mapping against the UEQ benchmark placed the six scales: Attractiveness (2.10), Perspicuity (2.03), Efficiency (1.92), Dependability (1.97), Stimulation (2.40), and Novelty (1.74) in the ‘Excellent’ category with a position in the range of the top 10% results. This top decile position indicated competitive advantage among similar products, yet it still left room for strategically valuable local improvements: streamlining repetitive steps to enhance Efficiency, aligning core terminology/icons to reduce variation in Perspicuity, and enriching novelty elements to ensure a more consistent perception of Novelty across all segments. By focusing on these three areas while maintaining the strengths of Stimulation and Attractiveness, pragmatic quality was expected to approach hedonistic quality more evenly in the next measurement.



**Fig. 6.** Ambatig benchmark results graph

## 5 Conclusion

UEQ measurements showed that the Ambatig user experience was very positive and balanced: Attractiveness 2.10; Pragmatic Quality 1.97; and Hedonic Quality 2.07; indicating that the application helped with task completion while also being enjoyable to explore. At the scale level, Stimulation stood out the most (~2.40), and Attractiveness was high (2.10), while Efficiency (1.92) and Novelty (1.74) were the areas that needed the most refinement without

compromising the existing clarity and sense of control. All confidence intervals were positive, and reliability was adequate, so these findings could serve as a basis for incremental improvements—streamlining repetitive steps, clarifying key terms/icons, and adding novelty elements; while maintaining strengths in engagement and appeal. In comparison, all scales fell into the ‘Excellent’ category, affirming Ambatig’s competitive position.

**Acknowledgments.** This research was funded by the PNB Fund of Medan State University in 2024. The researcher would like to express gratitude to the Research and Community Service Institute of Medan State University for facilitating all research activities.

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