博士学位論文審査要旨

２０２２年1月１２日

論 文 題 目：Quantitative Evaluation Enabling to Visualize Design Process for Product Design Education
（デザインプロセスの可視化を可能とするプロダクトデザイン教育のための定量的評価法に関する研究）

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要　　旨：

本論文は，デザインプロセスの可視化を可能とする，プロダクトデザイン教育のための定量的評価法を提案し，学生を対象とした事例研究を通じてその有効性を検証したものである．デザイン教育においては教員の主観的評価とは別に，客観的かつ定量的にデザインを評価する仕組みづくりが求められている．特に制作されたデザインが，どのような意思決定を経た結果なのか，決定されていくプロセスを定量的に確認できることが教育上極めて重要である．協働作業としてのデザインプロセスには複雑な意思決定変数が含まれる可能性がある．そのため結果としてのデザインに対する意思決定の一貫性を検証可能とするには，トレーサビリティと定量化が必須となる．そこで，デザインに関わるウェブベースの意思決定システムに，感性や好みなどの定性的な要素を定量的に扱うことができる階層分析法（AHP: Analytic Hierarchy Process）を適用して，デザインに関わる意思決定プロセスを構造化・定量化し，可視化する仕組みを提案している．その上で，デザイン教育コースの学生を対象とした３つの実践的な研究事例について，デザインプロセスの可視化と定量的評価の必要性や意義について論ずるとともに，提案の定量的評価法を適用して，その有効性・有用性を検証している．

本論文は，プロダクトデザイン教育におけるデザインプロセスの可視化と定量的評価に関する先駆的かつ基礎的な研究であり，これらの成果はこの分野の発展に多大なる貢献をなすものである．よって本論文は博士（工学）（同志社大学）の学位論文として十分な価値を有するものと認められる．

総合試験結果の要旨

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要　　旨：

論文提出者は，本学大学院理工学研究科情報工学専攻博士課程（後期課程）に在籍している．本論文の主たる内容は IEEJ Trans. on Electronics, Information and Systems, Vol.140, No.8, Int. Conf. on Electronics and Software Science 2019/2018, Int. J. of Artificial Life and Robotics, Vol.18, Issue 3 等に掲載され，十分な評価を得ている．

2022 年 1 月 8 日 14 時から 1 時間 40 分にわたって提出論文に関する学術講演会（博士論文公聴会）が開催され，種々の質疑討論が行われ，論文提出者の説明により十分な理解が得られた．さらに講演会終了後，審査委員により論文に関連した諸問題につき口頭試問を実施した結果，十分な学力を有することが確認できた．

提出者は，英語による論文発表や語学試験に合格しており，十分な語学能力を有すると認められる．よって総合試験の結果は合格であると認める．

博 士 学 位 論 文 要 旨

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要　　旨：

Design evaluation, especially product design evaluation, used to be performed by some kind of professions for design authority who has been considered to be famous and well-established at that relevant fields. Almost all designers, who want to design by themselves, sometimes had to be obeyed to such professions and design authority, but they had no special information such as how to improve their design results and/or how to modify theirs into more acceptable ones by means of decision by such professions and authority. It seems that the reason is that the evaluation of the design sometimes includes the subjective evaluation of the evaluation side.

From my own experience, it could be said that there might be a few viewpoints for evaluation criteria on the evaluation sides. Therefore, if not always, such evaluation criteria are frequently reflected in the fact that there are differences from case to case. Naturally, there are things that are sensuously, subjectively, and arbitrarily described as "cool" or "beautiful," so we do not intend to deny such so-called instinctive subjectivity. However, "design" should be an accurate response to the needs of the owners or the market, who actually want or obtain outputs from design, so design itself is to be decisively different from "art" that pursues pure beauty and unique expression.

Some kinds of ambiguity in design evaluation that many designers have felt frequently can be said to be the same at Design Education sites, which means not only design course of art universities but also how to teach "learning design". The evaluation (judgment of good or bad) used to be made by the subjective evaluation of the evaluators (sometimes, teachers) for the design proposal or results which had been made by the learners. In such a case, evaluation of design sometimes introduced a big difference. Learners' anxiety increases more and more when they do not know what criteria are employed to determine a good design. It is clear that such ambiguity contributes to the confusion of learners in designing. Namely, we have been suffering from existence of ambiguity in design evaluation from the school days of learning design. We would like to decrease such unnecessary ambiguity in design evaluation.

In order to solve these problems, it is necessary to create a mechanism to evaluate design quantitatively (in the field of design education to learn design). This is different from the subjective and instinctive evaluation of beauty (judgment of good or bad). The objective in

this research is to create a mechanism that allows any evaluator to obtain the same evaluation to some extent.

For the sake of construction of quantitative evaluation methods, it is necessary to trace the relevant process of determining the design and recognize how selection and/or determination finally produced design goals. For example, by means of clarifying how the design creator made the design, it should be possible to understand the intention of the creators namely designers as to how honestly they are responding to their needs.

Based on the previous experience so far, it had been not so important to know and/or understand why his design has been adopted in the process of design decision nor how this design proposal has been decided, and so on. The process leading up to completion has been left unclear, after completion. There was a current situation where it was left unreasonable. It is necessary to visualize such a buried and unclear process in order to trace the relevant process of determining the design and recognize how selection and/or determination finally produced design goals. We are aiming to visualize the process as an effective way to quantitatively evaluate the finished design.

We have carried out three practical research examples. From these examples, we have recognized necessity of some scheme to acquire user's requirement and tendency of likeness. Therefore, we have developed a Web-based questionnaire system to provide question and to obtain answer to/from specified users in order to utilize collaborative design approach.

Collaborative design is a suitable approach to obtain useful and practical results within a group of people in a relatively short period. Since the design process can involve complex decision-making variables, traceability and confirmation are very important to validate the consistency of decision making toward results design. It will be remaining how to confirm and visualize the designed results in quantitative procedure, although we have decided to employ Kansei Engineering to achieve a respectable performance of collaborative design and to apply it to Web system for decision-making.

We will describe our approach and its trial solution to demonstrate consistency in evaluating product design based on collaboration using the Analytic Hierarchy Process (AHP)-based calculation for confirmation. And we are sure that we will be able to extend our same approach and solution about utilization Kansei Engineering-based product design and Quantitative verification of designed results through AHP methodology to more useful fields of education not only in product design but also other attractive ones.