Advances in Management & Applied Economics, Vol. 14, No. 2, 2024, 13-22
ISSN: 1792-7544 (print version), 1792-7552(online)
https://doi.org/10.47260/amae/1422
Scientific Press International Limited

Investigating Parents' Satisfaction with Campus Architecture Planning Using the DQI and Kano Two-Dimensional Quality Model: A Case Study of an Elementary School in Northern Taiwan

Ho-Mei Yao[1] and Yi-Long Hsiao[2]

Abstract

The current design of campus buildings often lacks a thorough exploration of user needs. This study addresses this gap by developing a questionnaire based on the three design dimensions of the Design Quality Indicator (DQI) to assess design quality. Data collected through this questionnaire, along with the application of the Kano two-dimensional quality model (Kano Model) and Customer Satisfaction Coefficient (CSC), are utilized to identify the quality attributes of school buildings from the perspective of users. The study aims to locate the quadrant representing the overall user "satisfaction" and identify satisfactory elements. These findings can serve as essential references for future school construction designs.

The sample for this study is derived from a Type A school in the northern region, with parent feedback obtained through a questionnaire survey. The research results indicate that, through the methodology constructed in this study and the proposed planning and design strategies, items meeting parental expectations and satisfaction can be inferred, contributing to the creation of a satisfactory campus architectural form. It is recommended for future research to expand the sample size to obtain a more comprehensive understanding for the planning and design of campus buildings.

JEL classification numbers: I28.
Keywords: Design Quality Indicator (DQI), Customer Satisfaction Coefficient (CSC), Kano two-dimensional quality model, Campus architecture.

[1]Wenlin Elementary School, Beitou District, Taipei City, Taiwan.
[2]Department of Finance, National Dong Hwa University, Taiwan.

Article Info: Received: December 2, 2023. Revised: January 3, 2024.
Published online: January 7, 2024.

1. Introduction

School architecture is distinct from other buildings in its connotations and the inherent nature of education. When a school building is completed, it not only serves as a venue for implementing education, but is also expected to become a silent facilitator of educational practices (Wu, 2018).

Traditionally, school building architecture has been planned by architects first before undergoing discussion. With architects spearheading the process, there is a lack of large-scale participation by parents and neighborhood communities in the design process. Taking a metropolitan school in northern Taiwan as a case study (School A), there are plans to develop the architectural layout and volumetrics. Therefore, by integrating the DQI (Data Quality Index) and Kano two-dimensional quality models, this study aims to explore what the important requirements are for campus architectural planning.

2. Literature Review

2.1 Discussion on Campus Architecture and Architectural Engineering Design Quality Indicators

Buildings must be conducive to the practice of the educational process, improve the quality of the learning environment, and create schools that meet future needs and expectations.

The school buildings constructed today will still exist in 50 years. As the carrier of education, school architecture not only requires structural strength for 50 years, but campus facilities also need to be able to adapt to future social developments and possible reforms, in order to guarantee that education can keep up with educational inheritance and innovation for at least the next 50 years (Wu, 2018).

By using architectural engineering design quality indicators (Design Quality Indicator, DQI), suitable planning requirements can be identified and good architectural design quality can be determined. In 1999, the UK Construction Industry Council proposed a set of methods for measuring architectural engineering design quality - the Design Quality Indicator (DQI) model (Gann et al, 2003). The DQI has three constructs (Markus, 2003). Based on the three major design constructs of the DQI, indicators were developed to examine design quality, with a total of ten indicator items.

(1) Functionality construct: There are 3 indicators under the functionality construct.
Use - 7 question items total
Access - 7 question items total
Space - 6 question items total

(2) Building quality construct: There are 3 indicators under the building quality construct.
Performance - 10 question items total
Engineering - 8 question items total
Construction - 7 question items total

(3) Impact construct - There are 4 indicators under the impact construct.
Urban and social integration - 6 question items total
Internal environment - 8 question items total
Form and Materials - 5 question items total
Character and Innovation - 6 question items total

2.2 Kano Two-Dimensional Quality Model

An important theory for product design and product quality is the Kano two-dimensional quality model. The five quality attribute categories defined in the Kano model are described as follows (Lu, 2016):
One-Dimensional Quality [O]: The greater degree to which this quality content is present, the more satisfied users will be.
Must-Be Quality [M]: If this quality content is provided, users will not necessarily feel satisfied. However, if it is not provided, users will experience severe dissatisfaction.
Attractive Quality [A]: Providing this quality content will greatly please users. If it is absent, users will be indifferent or begrudgingly accepting, and will not feel dissatisfied.
Indifferent Quality [I]: Whether or not this quality content is provided, it does not lead to user satisfaction or dissatisfaction.
Reverse Quality [R]: Providing this quality content will cause users to feel dissatisfied. If it is not provided, it will instead lead to user satisfaction.

2.3 Kano Two-Dimensional Quality Attribute Classification

The way users select quality attributes and content will be categorized through different semantics. By comparing the binomial questionnaire and Kano quality attribute interpretation table, the "Kano quality attribute" classification is completed. Referencing Matzler and Hrinterhuber's (1988) quality analysis elements (as shown in Table 1), users select one of five statements that best expresses their feeling: 1. I like it that way; 2. It must be that way; 3. I am neutral; 4. I can live with it that way; 5. I dislike it that way. These are the questionnaire response options. By analyzing the results selected from both the positive and negative question responses, the corresponding Kano quality attribute is determined for requirements assessment.
Through distributing and analyzing the results of the questionnaire, the users' emotional attributes are obtained via the questionnaire. The "quality attributes" are derived from the users' questionnaire responses.

Table 1: Kano Two-Dimensional Quality Attribute Comparison Table

		Reverse side question item				
		I like it	It must be	I am neutral	I can live with it that way	I dislike it
Positive side question item	I like it	Invalid elements	Attractive Quality (A)	Attractive Quality (A)	Attractive Quality (A)	One-Dimensional Quality (O)
	It must be	Reversed elements	Indifferent Quality (I)	Indifferent Quality (I)	Indifferent Quality (I)	Must-Be Quality (M)
	I am neutral	Reversed elements	Indifferent Quality (I)	Indifferent Quality (I)	Indifferent Quality (I)	Must-Be Quality (M)
	I can live with it that way	Reversed elements	Indifferent Quality (I)	Indifferent Quality (I)	Indifferent Quality (I)	Must-Be Quality (M)
	I dislike it	Reversed elements	Reversed elements	Reversed elements	Reversed elements	Invalid elements

Source of information: Matzler, K and Hinterhuber, H.H. (1988)

2.4 Customer Satisfaction Coefficient (CSC)

Matzler and Hrinterhuber (1988) proposed improvement criteria for quality attributes. The "Kano quality attributes" do not fully present whether "quality is sufficient." By applying the customer satisfaction coefficient (CSC), the overall impact on user "satisfaction" can serve as an important reference for future school construction designs. The formulas are shown below.

Satisfaction Coefficient Index: $(A + O) / (A + O + M + I)$ (1)

Dissatisfaction Coefficient Index: $-(A + O) / (A + O + M + I)$ (2)

where: A: Attractive; O: One-Dimensional; M: Must-Be; I: Indifferent

After statistical analysis, when the "Satisfaction Coefficient Index" is closer to 1, it indicates that the quality content has a greater impact on fulfilling user requirements and satisfaction. When the "Dissatisfaction Coefficient Index" is closer to -1, it represents that the quality content has a greater influence on user dissatisfaction. Therefore, by prioritizing or adjusting items with index scores approaching 1 and -1, it will aid school construction planning in meeting user requirements.

3. Research Design and Implementation

The main research subjects of this study are the parents of School A. The content is divided into two parts. The first part is the subjects' basic information, including: gender, age, affiliated group. The second part is the questionnaire content, using Kano's two-dimensional quality model double questionnaires, which were self-compiled by the researcher.

3.1 Research Questionnaire Structure

The main research subjects of this study are the teachers, staff, parents and others of School A. Questionnaires were distributed through online surveys and paper questionnaires. The content is divided into two parts. The first part is the subjects' basic information, including: gender, age, affiliated group. The second part is the questionnaire content, using Kano's two-dimensional quality model double questionnaires. The question structure is based on exploring important questionnaire items regarding building requirements according to the three constructs and ten indicators of the DQI model. 58 positive questions were designed, totaling 116 double questionnaire items.

3.2 Questionnaire Content

The questionnaire design of this study is based on the three major design constructs of the DQI model. The questionnaire items of this study consist of three major constructs and ten items.

The first Functionality construct includes three indicators – Use, Access and Space. Some original items were revised: "Campus buildings can enhance organizational operational effectiveness (FU2)" was changed to "The campus has buildings for long-term care/elderly care (FU2)"; "Campus buildings allow users to create more activities (FU3)" was changed to "The campus has childcare/infant care buildings (FU3)"; "Activities and work within campus buildings are safe (FU4)" was changed to "The campus has community mental health center buildings (FU4)"; "Campus buildings can accommodate future spatial expansion or change needs (FU5)" was changed to "The campus has social housing buildings (FU5)"; "The air conditioning, electrical, plumbing and drainage piping systems have adjustability (FU7)" was changed to "The campus has community parking lots (FU6)"; and "The interior spaces of campus buildings have flexibility in use (FU6)" was changed to "The interior spaces of campus buildings have diverse usage (FU7)." There are 38 items with positive and negative question meanings.

The second Building Quality construct includes three indicators – Performance, Engineering and Construction. There are 36 items with positive and negative question meanings.

The third Impact construct includes four indicators – Urban and Social Integration, Internal Environment, Form and Materials and Character and Innovation. There are 42 items with positive and negative question meanings.

Each item has 5 selections representing different degrees of psychological feeling, including "Dislike," "Can Tolerate," "Indifferent," "Must Be," and "Like." All are single choice questions. In total there are 58 positive questions and 58 negative questions. The following questionnaire survey content is divided into four major sections, with 116 total questionnaire items.

The questionnaire coding refers to the indicator content of the DQI to correspond with the requirements of School A educational staff. The original indicators were coded using the first alphabetic letter of the construct and number, e.g. the first

question under the Functionality construct is coded FU1. If it is a negatively phrased question, then FU1-1 is used.

4. Research Analysis and Results

4.1 Parents Group Quality Improvement Matrix Analysis

The quality improvement matrix for the parents group is shown in Figure 1. The analysis of the distribution of items across the four quadrants is as follows:

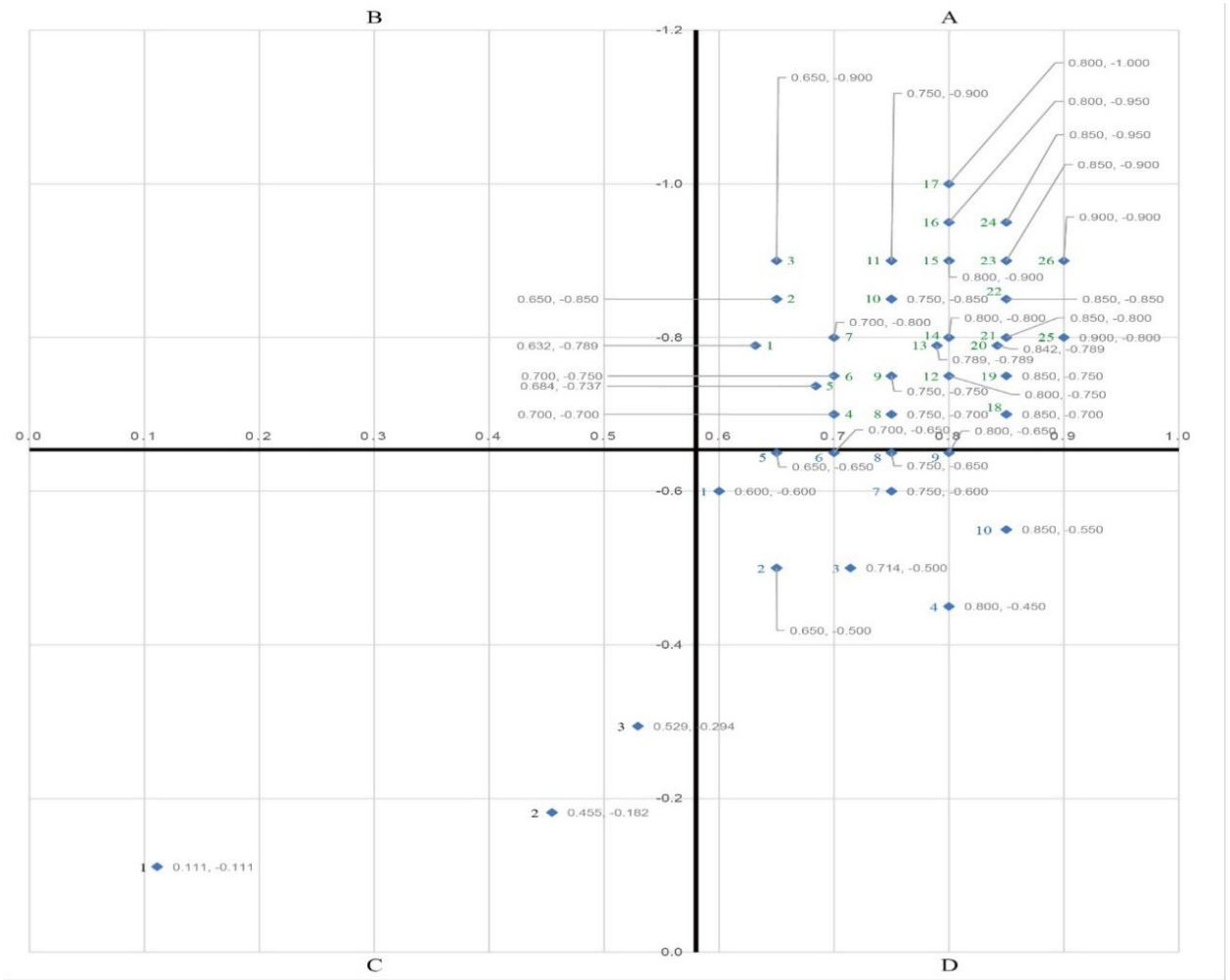

Figure 1: Parents Group Quality Improvement Matrix

4.1.1 Analysis of Parents Group Quadrant 1 Items

In the parents group quality improvement matrix, Quadrant 1 has a total of 26 items, distributed as shown in Figure 1. The Quadrant 1 items are:

A1. "Campus buildings make positive contributions to the neighborhood environment (IU2)"; A2. "Appropriate planning of the ratio of actual usable area to total area within campus buildings (FS2)"; A3. "People with disabilities and wheelchair users can easily access campus buildings (FA3)"; A4. "Pleasing and pressure-free exterior design of campus buildings (IF1)"; A4-1 "Appropriate planning of logistics and waste handling circulation (FA4)"; A5. "Campus buildings can meet the needs of different users (FU1)"; A6. "Appropriate planning of the layouts and areas of various spaces within campus buildings (FS1)"; A7. "Engineering systems within campus buildings are easy to maintain and replace (BE3)"; A8. "The construction and design of campus buildings make significant contributions to new technologies (IC5)"; A8-1 "Consideration in campus building design of future impacts of climate change (BC7)"; A9. "Appropriate planning of campus building orientation and configuration (IF2)"; A9-1 "Consideration in campus building construction of future component reuse and recycling (BC4)"; A9-2 "Integration of campus building skyline, massing and height with the surrounding environment (IU1)"; A10. "Integration of campus building skyline, massing and height with the surrounding environment (IU1)"; A10-1 "Proper integration of campus building exterior and interior finishes (BC6)"; A10-2 "Clear layout and explicit collaborative relationships of various engineering systems within campus buildings (BE5)"; A10-3 "Campus building entrances are clear and clearly marked (FA7)"; A11. "Campus building design can effectively reduce HVAC and mechanical ventilation requirements (BE4)"; A11-1 "Indoor air quality within campus buildings is adequate (BP8)"; A11-2 "Proper planning in the construction process of construction materials and methods (BC2)"; A12. "Appropriate planning of interior circulation distances within campus buildings (FS3)"; A13. "Neighborhood residents generally like the campus buildings (IU6)"; A14. "Campus buildings incorporate water-saving and energy-saving designs or installations (BE1)"; A14-1 "Appropriate artificial lighting controls in campus buildings (BP7)"; A14-2 "Reasonable massing and composition of campus buildings (IF5)"; A15. "Adequate lighting and signs in outdoor spaces, paths, stairs (FA5)"; A15-1 "Interior spaces in campus buildings are not overly crowded or cramped (II1)"; A15-2 "Clear demarcated refuge areas and fire strategies within campus buildings (BE6)"; A15-3 "Facility management within campus buildings is good (BP1)"; A15-4 “Public spaces and circulation planning within campus buildings make people feel relaxed and happy (II2)”; A16. “Structural design and seismic safety of campus buildings is secure (BE8)”; A17. “Safe construction process of campus buildings (BC3)”; A18. “Interior spaces of campus buildings have diverse usage (FU7)”; A18-1 “Effective integration of structure, engineering systems and layouts of campus buildings (BC5)”; A19. “Campus buildings coalesce greater centripetal force of teachers, students and staff (IC4)”; A20. “The campus

has childcare/infant care buildings (FU3)"; A21. "Good visibility within and outside campus buildings (II8)"; A22. "Feeling happy around the spaces surrounding the campus buildings (IU3)"; A23. "Campus buildings facilitate student access and parent pick-up/drop-off (FA1)"; A23-1 "Components and materials of campus buildings have durability (BP3)"; A24. "Campus buildings appropriately control personnel access (II7)"; A24-1 "Proper planning of fire safety circulation to provide emergency rescue work (FA6)"; A25. "Overall daylighting conditions within campus buildings make people feel comfortable (II3)"; A26. "Campus buildings have superior sound insulation/daylighting design (BP5)". There are a total of 43 items.

4.1.2 Analysis of Parents Group Quadrant 2 Items

In the parents group quality improvement matrix, Quadrant 2 has 0 items, distributed as shown in Figure 1 There are no "reduce user dissatisfaction" items in Quadrant 2.

4.1.3 Analysis of Parents Group Quadrant 3 Items

In the parents' group quality improvement matrix, Quadrant 3 has a total of 3 items that can be postponed for provision, distributed as shown in Figure 1: C1. "The campus has social housing buildings (FU5)"; C2. "The campus has long-term care/elderly care buildings (FU2)"; C3. "The campus has community mental health center buildings (FU4)". There are a total of 3 items.

4.1.4 Analysis of Parents Group Quadrant 4 Items

In the parents group quality improvement matrix, Quadrant 4 has a total of 10 items, distributed as shown in Figure 1.

The Quadrant 4 items that increase user satisfaction are: D1. "Adequately planned appropriate storage spaces within campus buildings (FS5)"; D2. "Campus buildings linked to organizational vision or values (IC3)"; D2-1 "Campus building design positively contributes to the regional urban landscape (IU5)"; D3. "The campus has community parking lots (FU6)"; D4. "Campus buildings are interesting making people want to walk around (IC2)"; D5 "Campus building spatial planning considers gender friendly issues (FS4)"; D6 "Campus buildings provide sufficient parking for teachers, angel class parents and visitors (FA2)"; D7 "Appropriate and attractive overall textures and colors of campus buildings (IF4)"; D8. "Campus buildings can serve as a model example for similar future school construction (IC6)"; D8-1 "Material usage reflects architectural purpose and function (BC1)"; D9. "Integration of existing neighborhood environmental facilities with campus buildings (IU4)"; D10. "Campus building design has meaningful concepts or ideas (IC1)". There are a total of 12 items.

4.1.5 Parents Quality Improvement Matrix Summary

In the parents quality improvement matrix, there are 43 items for priority implementation. There are 3 items that can be postponed: “The campus has social housing buildings (FU5)”; “The campus has long-term care/elderly care buildings (FU2)”; and “The campus has community mental health center buildings (FU4)”. These 3 items are EOD-recommended items for School A to consider incorporating. There are 12 items to increase user satisfaction, including: “Adequately planned appropriate storage spaces within campus buildings (FS5)”; “Campus buildings linked to organizational vision or values (IC3)” and “Campus building design positively contributes to the regional urban landscape (IU5)”; “The campus has community parking lots (FU6)”; “Campus buildings are interesting making people want to walk around (IC2)”; “Campus building spatial planning considers gender friendly issues (FS4)”; “Campus buildings provide sufficient parking for teachers, angel class parents and visitors (FA2)”; “Appropriate and attractive overall textures and colors of campus buildings (IF4)”; “Campus buildings can serve as a model example for similar future school construction (IC6)” and “Material usage reflects architectural purpose and function (BC1)”; “Integration of existing neighborhood environmental facilities with campus buildings (IU4)”; “Campus building design has meaningful concepts or ideas (IC1)”.

5. Research Conclusions and Recommendations

5.1 Research Conclusions

In the quality improvement matrix analysis, parents believe there are 43 items that should be prioritized for implementation. There are 3 items that can be postponed: “The campus has social housing buildings (FU5)”; “The campus has long-term care/elderly care buildings (FU2)”; and “The campus has community mental health center buildings (FU4)”. These 3 are EOD-recommended items for incorporation. There are 12 items to increase user satisfaction, including: “Adequately planned appropriate storage spaces within campus buildings (FS5)”; “Campus buildings linked to organizational vision or values (IC3)” and “Campus building design positively contributes to the regional urban landscape (IU5)”; “The campus has community parking lots (FU6)”; “Campus buildings are interesting making people want to walk around (IC2)”; “Campus building spatial planning considers gender friendly issues (FS4)”; “Campus buildings provide sufficient parking for teachers, angel class parents and visitors (FA2)”; “Appropriate and attractive overall textures and colors of campus buildings (IF4)”; “Campus buildings can serve as a model example for similar future school construction (IC6)” and “Material usage reflects architectural purpose and function (BC1)”; “Integration of existing neighborhood environmental facilities with campus buildings (IU4)”; “Campus building design has meaningful concepts or ideas (IC1)”.

5.2 Research Recommendations

On the quality improvement matrix, items that can be postponed for implementation include: “Long-term care/elderly care buildings (FU2)”; “Community mental health center buildings (FU4)”; and “Social housing buildings (FU5)”.

Parents believe on the quality improvement matrix that “Long-term care/elderly care buildings (FU2)” and “Community mental health center buildings (FU4)” should be postponed.

References

[1] Gann, D., Salter, A. and Whyte, J. (2003). Design Quality Indicator as a tool for thinking, Building Research and Information, 31(5), pp.318-333.

[2] Kano, N., Seraku, N., Takahashi, F. and Tsuji, S. (1984). Attractive quality and must-be quality, Journal of Japanese Society for Quality Control, 14(2) pp.38-48.

[3] Lu, K. D. (2016). Exploring Smart City Development Strategies Using the Kano Two-dimensional Quality Model: A Case Study of Taichung City. National Taiwan University of Science and Technology.

[4] Markus, A. T. (2003). Lessons from the Design Quality Indicator. Building Research and Information, 31(5), pp.399-405.

[5] Matzler, K. and Hinterhuber, H. H. (1988). How to make product development projects more successful by integrating Kano’s. Technovation,18(1), pp.58-38.

[6] Wu, G. F. (2018). A Study on Post-evaluation of School Architecture Planning and Design: A Case Study of Xuguang Elementary School Campus. National Chi Nan University.