Priority in Design Principles of Educational Space in Evaluating the AKSI-ADB Project Scheme

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ABSTRACT

One of the essential elements for Indonesian university quality assurance is the availability of educational facilities. The infrastructure and amenities provided in the learning environments affect the efficacy of the educational process. Based on existing data, only 30% of universities in Indonesia meet the minimum criteria for quality campus infrastructure. Asian Development Bank (ADB), by Advance Knowledge and Skill for Sustainable Growth (AKSI) scheme, provides grants and loans to several universities in Indonesia to develop infrastructure and facilities so that the educational process can be more optimal. This research aims to determine the priority scale of design in terms of the principles of educational space design. The information collected in this research will be utilized to assess multiple campuses established through funding provided by ADB. Data was collected and analyzed using an Exploratory Sequential Mixed Methods Design. Exploration by architects regarding priority principles/criteria for educational campus designs through Focus Group Discussions. The collected data is then analyzed using the analytic hierarchy process (AHP). The outcome of this study will be the development of design parameters rooted in educational space design principles. These parameters will serve as a tool to evaluate universities established with funding from ADB.

Keywords: Education Facilities, ADB, Educational Space, Campus Design, Quality of Education.

1. INTRODUCTION

Infrastructure plays a crucial role in education, making educational facilities a significant factor in ensuring the quality of education, particularly in higher education. Within the architectural context, the performance of buildings directly contributes to the quality of education as its outcome. There are four leading indicators for measuring building performance: functional requirements related to building functions, performance requirements associated with the physical performance of buildings and installation of complementary infrastructure, legality requirements related to regulations, and user requirements related to convenience and costs that the user must issue [1].

The performance of the building in this paper refers to the quality of the facilities as a place for implementing teaching and learning. Many factors affect the quality of tertiary education, such as curriculum, teacher competency, student capacity, and supporting infrastructure [2]. Suryadi's research [3] shows a reasonably strong correlation between the Building Performance and Higher Education Institutional Performance variables. The relationship between building performance and overall institutional performance in higher education contributed 22%.

The demand for high-quality educational facilities remains significantly higher than what both public and private institutions can currently offer. Among a total of 400 public universities and 4,186 private universities (under the management of the Ministry of Research, Technology and Higher Education, Ministry of Religion, and official education), only a maximum of 30% can meet the minimum requirements for infrastructure standards [4][5].

1.1. Loans for Educational Facilities

Amid limited state budgets, one of the efforts to improve the quality of higher education facilities and infrastructure was obtained through the Financing of Foreign Loans and Grants (PPHLN). Asian Development Bank (ADB), by Advance Knowledge and Skill for Sustainable Growth (AKSI) scheme, provides grants and loans to several universities in Indonesia to develop infrastructure and facilities so that the educational

process can be more optimal. Riau University (UNRI), Jambi University (UNJA), Malikulsaleh University (UNIMAL), and the Indonesian University of Education (UPI).) are several of the higher education campuses that received the PPHLN funded by the Asian Development Bank (ADB) [6].

The primary objective of this study is to assess the degree to which the architectural design of the four campuses included in the AKSI-ADB project scheme aligns with the educational space design parameters. Since the campus project is currently in the preparatory and construction phases, with no universities having reached the operational stage yet, the research focuses solely on aspects related to architectural design. By gaining insights into the design quality, this study aims to provide an overview that can influence the development of university campuses' academic and non-academic environments. Ultimately, this has the potential to enhance the overall quality of tertiary institutions.

1.2. Educational Campus Principles

University campus design must prioritize the process of learning and educational development. An educational campus demonstrates a dedication to excellence and the overall growth of the academic community, encompassing intellectual, social, and psychological development. This campus type should provide a supportive environment for its members' creativity and innovative contributions, enhancing the university's overall excellence.

Sotelo's principles [7] for designing an educational campus provide a framework for creating an environment that facilitates education, learning, and academic excellence. Ten principles offer an environment that promotes learning, creativity, and opportunities for students to engage in extracurricular activities and develop essential life skills. A well-designed campus will invite more high-quality research, leading to a more substantial academic reputation and increasing opportunities for external research funding. In addition, an excellent campus can enhance community and pride among students and faculty members. That sense of belonging creates a positive campus culture and a more vibrant learning environment. The ten ideal education campus principles include (1)Utopia and integrated planning; (2)Community of learning; (3)Spatial harmony; (4)Emotional and intellectual harmony; (5)Nature and art; (6)Image and accessibility; (7)Sustainability and adaptation to the environment; (8)Memory and avant-garde; (9)The university-city relationship; and (10)Innovative teaching and learning.

1. *Utopia and integrated planning.* This parameter aims to develop a perfect, integrated environment that encourages the peaceful coexistence of various campus features. Integration in campus planning refers to the deliberate and strategic coordination of various elements and components within a campus environment to create a unified and cohesive whole. It involves considering the interconnections and relationships between buildings, open spaces, pathways, infrastructure, and natural elements.

2. *Community Learning.* This foundation for design concepts emphasizes creating an environment that fosters collaboration, social interaction, and a sense of community among students, faculty, and staff. Campus design can support and enhance this community by creating spaces that encourage interaction, collaboration, and intellectual growth. For example, the layout of classrooms, study areas, and shared spaces can be designed to facilitate group discussions, teamwork, and informal learning exchanges.

3. *Spatial harmony,* which emphasizes the necessity for a balanced and unified arrangement of areas, is a key element influencing campus design. A harmonious and efficient campus layout results from carefully considering building placement, circulation routes, and open spaces. Integrating buildings with nearby natural components, such as trees and landscaping, to create a seamless transition between interior and outdoor spaces is an example of spatial harmony in campus architecture. In addition, the thoughtful placement of facilities and communal spaces promotes social interaction and builds community.

4. *Emotional and intellectual harmony.* This indicator incorporates elements and spaces that inspire creativity, critical thinking, and personal reflection. The campus design aims to create an atmosphere that nurtures holistic development and a positive educational experience by prioritizing emotional and intellectual harmony. For example, a campus may include serene outdoor areas with seating and greenery for students to relax and recharge and vibrant communal spaces that maintain social interaction and collaboration.

5. *Nature and art* is a concept that emphasizes the importance of integrating natural elements and artistic expression into the campus environment. It recognizes that the built environment is not just about functionality but also about creating a sense of place and aesthetic appeal. This includes designing spaces that incorporate natural elements such as water, plants, and artwork that reflect the culture and identity of the campus community. An example of nature and art in campus design could be creating a sculpture garden or outdoor art installation that celebrates the beauty of nature and promotes creativity and contemplation.

6. *Image and Accessibility.* Developing a campus with a focus on accessibility as its core points out the value of encouraging an inclusive community that meets the various requirements of all people. According to this idea, the campus must be barrier-free and accessible to

those with disabilities [8]. Additionally, accessible design takes into account digital accessibility in addition to physical accessibility, offering tools and platforms that are usable by everyone. Educational institutions advance equitable opportunities and foster an open and welcoming atmosphere for all campus community members by giving accessibility a high priority in campus design.

7. Sustainability and adaptation to the environment. Sustainability is a fundamental principle in campus design, emphasizing the responsible and efficient use of resources to minimize adverse environmental impacts and promote long-term ecological balance. This includes incorporating renewable energy systems, utilizing sustainable materials, implementing efficient waste management practices, and creating green spaces that enhance biodiversity. For example, sustainability in campus design could involve installing solar panels to generate renewable energy, using recycled and locally sourced materials in construction, and implementing water-saving measures such as rainwater harvesting and efficient irrigation systems.

8. Memory and avant-garde. These are concepts that the design of the campus should translate the reflection of its history while also providing opportunities to innovate with new ideas. In this case, the spatial concept focuses on creating spaces and facilities that honor the campus's heritage and traditions while also embracing cutting-edge technologies within the campus area. An example of this concept such as a classroom building with a classic architectural style, filled with simple and minimalistic interior design.

9. The university-city relationship. The correlation between cityscape and the university is vital in guiding campus design [9]. The architectural and urban context of the surrounding cityscape should be considered to ensure a harmonious integration of the university within its urban setting. This includes building height, scale, architectural style, and pedestrian connectivity. By aligning the campus design with the cityscape, the university becomes an integral part of the urban fabric, fostering a sense of place and creating opportunities for interaction between the campus and the larger community. For example, a university in a historic city may adopt architectural elements that reflect the local heritage, seamlessly blending into the surrounding urban context and enhancing the overall aesthetic appeal of the university and the cityscape.

10. Innovation in Teaching and Learning. Innovation in teaching and learning is a crucial principle in campus design, focusing on creating spaces and environments that foster creativity, collaboration, and active engagement among students and faculty. This involves integrating cutting-edge technologies, flexible learning spaces, and interactive resources to support diverse teaching methods and personalized learning experiences. For example, an application of innovation in campus design could include incorporating smart classrooms equipped with interactive displays, and collaborative workspaces with movable furniture, all aimed at enhancing student engagement and promoting innovative teaching practices.

The implementation of design principles for educational campuses is anticipated to facilitate the inclusion of innovative learning methods.

2. METHOD

Data was collected and analyzed using an Exploratory Sequential Mixed Methods Design [10]. A literature study was conducted in the early stages regarding the principles and criteria for designing educational spaces. A literature study produces more concrete parameters that describe each design indicator, as seen in Table 1. Next, exploration of the architect's perspective regarding priority principles and criteria for educational campus designs through focus group discussions (FGD). The data was then analyzed using the analytic hierarchy process (AHP). AHP is a structured technique for organizing and analyzing complex decisions and is an accurate approach to measuring decision indicator scale [11].
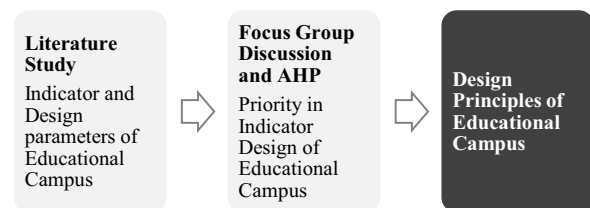

Figure 1. Exploratory Sequential Mixed Methods Design

In addition to this paper, the subsequent research phase aims to construct a decision-making model for assessing the quality of creative space utilizing a fuzzy logic system [12]. The final stage involves evaluating the design of various campuses within the AKSI-ADB project using this model, which will be detailed in a separate research publication. This study aims to derive a design principles model for assessing the campuses in the AKSI-ADB project, which will have implications for enhancing the university's academic and non-academic environments, ultimately contributing to improving tertiary institutions' overall quality.

Table 1. The output of literature study: Design parameters for Educational Campus Principal.

Code	Indicator		Parameters
EC1	Utopia and integrated planning	1	University Strategic Plan are comprehensively described in the Master Plan
		2	The Vision and Objectives of the University are described in the Master Plan
		3	Flexibility towards changes required in the master plan
		4	Academic and non-academic activities are accommodated in the Master Plan
EC2	Community Learning	5	Social interaction features are available between academics outside the classroom
		6	Features for more intimate personal interactions between users outside the classroom
		7	There is a place for study groups and student discussions outside of class
		8	Familiar and nuanced landscape of learning in campus layout
EC3	Spatial harmony	9	Campus layout is designed dynamically, varied and not monotonous
		10	Configuration and connection of environmental aesthetics of campus buildings
		11	The dynamics of the dimensions and volume of space, as well as the availability of active open space
		12	Tectonics and form aesthetics in campus design that encourage student architectural
EC4	Emotional and intellectual harmony	13	Curricular, co-curricular, and extra-curricular academic activities are accommodated in campus design
		14	Prayer room available
		15	Art and cultural space available
		16	Creativity in processing architectural forms, spatial planning and material
EC5	Nature and art	17	Natural elements are maintained and become an integral part of the architectural concept
		18	There is unity in the diversity of elements in the building, interior, exterior, open space, and landscape
		19	There is an open space with closure, which can be utilized to become an exhibition space for works of art
		20	There is an outdoor space that can be utilized and processed to become an exhibition space for works of art
EC6	Image	21	Strong architectural image as an educational building on campus architectural design
		22	The typology of educational buildings is depicted in the campus design
		23	the tridharma of higher education is depicted in the university plan
		24	Responsive to the richness of local architecture and traditions
EC7	Accessibility	25	Inclusive to gender
		26	Inclusive to children
		27	Inclusive to elderly people
		28	Inclusive to pregnant and lactating woman
EC8	Sustainability and adaptation to the environment	29	Campus design aligns with urban planning and context, and adapts to local geography and climate
		30	Green architecture applications, maintaining biodiversity and environmental conservation
		31	Application of construction materials with renewable energy management mechanisms
		32	Penerapan konsep Reduce, Reuse, Recycle
EC9	Memory and avant-garde	33	Adapt the diversity of local or traditional architecture
		34	Adaptation and projection of modern architecture
		35	Experimental and avant garde, but still based on local architecture
		36	A strong identity, both architecturally and intellectually and academically
EC10	The university-city relationship	37	Campus can become an icon or urban generator
		38	Academics, and the community can accommodate their activities in the campus area
		39	Connected and integrated with the architectural context of the city
		40	Campus provides facilities for social and economic activities of the surrounding community
EC11	Innovative teaching and learning	41	Flexible and attractive space for a variety of learning models
		42	Smart building system
		43	Smart campus system
		44	Smart classroom system

3. RESULT AND DISCUSSION

The primary objective of the research is to determine the standards for assessing design quality. Additionally, the study aims to develop a model that measures the quality of university campus designs based on the concept of creative space and evaluate the architectural design quality of four campuses in the AKSI ADB project using the criteria of the educational space design. However, this paper will focus on the first goal of identifying the requirements for measuring design quality.

Architects specializing in educational campus and creative space design were observed and interviewed by FGD to identify the factors used to evaluate design quality and qualitative data were gathered. Exploration by architects regarding priority principles/criteria for educational campus designs through Focus Group Discussions. This data was then analyzed using the Analytical Hierarchy Process (AHP) method to determine the relative importance of each criterion in assessing design quality.

The literature review and FGD found that ten indicators and 44 parameters require consideration during the design process of an educational campus. These parameters are derived from the original educational campus design indicator introduced by Sotelo (2010) [7] These criteria are listed in Table 1,

which are (EC1) Utopia and integrated planning; (EC2) Community of learning; (EC3) Spatial harmony; (EC4) Emotional and intellectual harmony; (EC5) Nature and art; (EC6) Image and accessibility; (EC7) Sustainability and adaptation to the environment; (EC8) Memory and avant-garde; (EC9) The university-city relationship; and (EC10) Innovative teaching and learning.

Table 2. AHP Comparison Rating Scale.

Level	Definition	Information
1	Both elements are equally important	The two elements have the same influence on the goal
3	One element is slightly more important than the other elements	Experience and judgment slightly favor one element over the other
5	One element is more important than the other	Experience and judgment strongly favor one element over the other
7	One element is clearly more important than the other elements	A strong element supported in its dominance has been seen in practice
9	One element is absolutely important than the other elements	Evidence that supports one element over another has the highest possible affirmation level
2, 4, 6, 8	Values between two adjacent judgment values	This value is given if there are two compromises between the two choices
opposite	If the element j gets one number when compared to element j, then j has the opposite value when compared to i	Available space as an indicator of cultural behavior. (example: students must be quiet and not make noise in the library)

Table 3. Comparison of main criteria pair matrix with priority scale for Educational Campus.

	EC01	EC02	EC03	EC04	EC05	EC06	EC07	EC08	EC09	EC10	EC11
(EC01) Utopia and integrated planning		2,0	4,0	6,0	4,0	6,0	2,0	2,0	4,0	6,0	2,0
(EC02) Community of learning			2,0	4,0	4,0	4,0	2,0	4,0	2,0	4,0	2,0
(EC03) Spatial harmony				4,0	2,0	4,0	2,0	4,0	2,0	4,0	4,0
(EC04) Emotional and intellectual harmony					2,0	2,0	4,0	6,0	4,0	2,0	4,0
(EC05) Nature and art						2,0	4,0	6,0	2,0	2,0	6,0
(EC06) Image							4,0	6,0	4,0	2,0	6,0
(EC07) Accessibility;								4,0	2,0	4,0	2,0
(EC8) Sustainability and adaptation to the environment									4,0	6,0	2,0
(EC9) Memory and avant-garde										4,0	6,0
(EC10) The university-city relationship											6,0
(EC11) Innovative teaching and learning.											

A pairwise comparison of the overall criteria for campus design is conducted to determine the most important criteria for assessing design quality. The quantitative analysis in this study compares various indicators and alternatives to make a decision, including selecting an indicator hierarchy using the AHP (Analytical Hierarchy Process) method. AHP in this study is used to compile criteria for assessing the quality of campus design based on the concepts of educational campus into an effective hierarchy. The process of numerical analysis involves transforming the comparison into a matrix Comparisons between elements use a scale of one to nine, with the assessment parameters seen in Table 2.

3.1. The Result of the Priority Scale in Educational Space Design Criteria

The AHP method uses the Expert Choice 2020 software by carrying out a pair-wise comparison model. Pair-wise comparisons were made at each level. Table 3 shows the geometric mean values of the pair-wise comparisons made by the architects between the main criteria and objectives. The intended goal is to use the educational campus Design parameters to fulfil the design. After that, the relative priority of the leading indicators is determined by calculating the priority weight.

The consistency principle is utilized to assign priority weights by assessing the level of inconsistency in comparisons through the consistency ratio (CR). According to this principle, the CR value should be below 0.10. In this research, the CR value for comparing primary criteria is 0.08, signifying that the indicator weighting adheres to the consistency principles and is deemed acceptable.

The findings indicate that sustainability and environmental adaptation (EC8) criteria hold the utmost significance in fulfilling the concept of an educational campus, representing the most significant scale of 23.5%. Other measures, such as Utopia and Integrated Planning (EC1), obtained a percentage of 15.8% while Teaching and Learning Innovation (EC11) achieved 15.3%, further highlighting their significance. Two criteria considered not a priority for evaluating educational campus designs are integration with the urban context (EC10) and imagery (EC6).
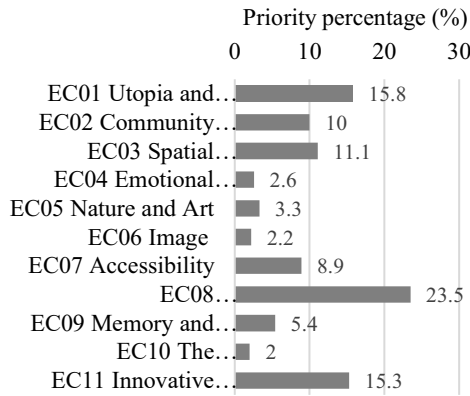
Priority percentage (%)

Figure 2. Priority percentage of Educational Campus Design Criteria.

Based on this research, sustainability and environmental adaptation have emerged as essential campus design criteria. With increasing concerns about climate change and the need for ecological balance, educational institutions need to prioritize sustainable practices in their design and operations. Incorporating energy-efficient systems, renewable energy sources, and environmentally friendly materials minimizes the carbon footprint and sets a positive example for students and the community. Additionally, creating adaptive spaces that harmonize with the natural surroundings enhances the well-being of students, promotes a sense of connection with nature, and fosters a conducive learning environment. By embracing sustainability and environmental adaptation as design principles, campuses can make significant strides in creating a more resilient and environmentally responsible educational ecosystem.

Principles is Utopia and Integrated Planning. Campus-integrated planning plays an essential role in enhancing the teaching and learning process. Integrating spaces create a cohesive and supportive educational environment by strategically coordinating the design and layout of various campus components, such as classrooms, libraries, laboratories, and shared spaces. Integrated planning ensures seamless connectivity between areas, [13] facilitating easy access and movement for students and faculty and promoting collaboration and engagement. Furthermore, it optimizes the allocation of resources, allowing for efficient utilization of technology, equipment, and facilities, directly impacting instructional quality. By considering future educational trends and advancements, integrated planning also enables the creation of adaptable and flexible learning spaces that can accommodate evolving pedagogical approaches and emerging technologies,

fostering an environment conducive to student-centered and innovative teaching methods.

The Third most crucial priority of campus design principles is Teaching and learning innovation. This indicator has a significant impact on the overall educational experience and outcomes. Technology in information and media has an essential role in the modernization of schools and in increasing the attractiveness of the teaching process [14-15]. Incorporating innovative approaches to teaching and learning in the design of campus spaces, institutions can create environments that encourage active engagement, collaboration, and creativity among students and faculty. This generates effective knowledge transfer, enhances student motivation and satisfaction, and facilitates the development of essential skills needed in the modern workforce. By prioritizing teaching and learning innovation in campus design, institutions can create dynamic and adaptable learning environments that align with the evolving needs of students and support their academic success.

Although the data shows that the university-city relationship criteria received the lowest rating, it is crucial to recognize the significance of these criteria. The contextual integration of the campus area and urban architecture holds immense importance in facilitating practical learning activities within the campus environment. This process directly impacts various aspects, including the availability of learning opportunities beyond the campus, generating collaborations and partnerships, and accessing urban amenities and services. Despite their lower scale rating, these criteria play a vital role in creating a conducive learning environment that extends beyond the confines of the campus, enhancing the overall educational experience.

Table 4. Priority scale of educational campus design criteria.

No	Criteria	Weight
1	Sustainability and adaptation to the environment	23,5
2	Utopia and integrated planning	15,8
3	Innovative teaching and learning	15,3
4	Spatial harmony	11,1
5	Community Learning	10
6	Accessibility	8,9
7	Memory and avant-garde	5,4
8	Nature and Art	3,3
9	Emotional and Intellectual Harmony	2,6
10	Image	2,2
11	The university-city relationship	2
Inconsistency = 0.03 with 0 missing judgments		

Tabel 5. Example of Design Principles for Educational Campuses

No	Criteria	Example of Design Principles	Reference Design Illustration
1	(EC01) Utopia and integrated planning	interconnections between buildings, open spaces, pathways, infrastructure, and natural elements.	
2	(EC02) Community of learning	The layout of classrooms, study areas, and shared spaces can be designed to facilitate group discussions, teamwork, and informal learning exchanges.	
3	(EC03) Spatial harmony	Integrating buildings with nearby natural components, such as trees and landscaping, to create a seamless transition between interior and outdoor spaces	
4	(EC04) Emotional and intellectual harmony	Availability of prayer room.	
5	(EC05) Nature and art	There is an open space with closure, which can be utilized to become an exhibition space for works of art	
6	(EC06) Image and (EC07) Accessibility	- Strong architectural image as an educational building on campus architectural design - Campus must be barrier-free and accessible to people with disabilities	

4. CONCLUSION

In conclusion, this research highlights the importance of sustainability and environmental adaptation as crucial campus design criteria. By prioritizing sustainable practices and creating adaptive spaces, educational institutions can reduce their environmental impact and provide a conducive learning environment. Integrated planning is the second most crucial priority, enabling cohesive and supportive campus environments that facilitate connectivity, resource optimization, and adaptability to future educational needs. Teaching and learning innovation, the third priority, significantly enhances educational outcomes by fostering active engagement and creativity among students and faculty. The eleven design principles hold differing degrees of significance, yet they offer a framework for assessing campus design through the lens of the educational space concept. As demonstrated in the previous Table 5, the design parameters for educational campuses are transformed into design criteria suitable for utilization in the planning or evaluation process of campuses. These findings emphasize the importance of considering multiple design principles to create holistic and practical campus environments.

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