

Environmental awareness in project-based urban and settlement architecture learning

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ABSTRACT: In view of today's high energy consumption, carbon emission and climate change, it is important to promote and build healthier cities with the aim of maintaining environmental balance. Hence, in this article, the authors present a project-based learning model to foster environmentally responsible behaviour through sustainable design. The participants in this study were students who programmed within urban and residential architecture courses at the STIKMA International College of Technology, East Java Province, Indonesia. In this study, students were observing activities in the Malang city square, then conducting a needs analysis and continuing with redesign. The results showed that there were three types of environmentally unfriendly behaviour found; namely: damaging vegetation, damaging public facilities and damaging environmental quality. The results of the study show that the project-based learning model has a positive influence on students' knowledge and environmental care attitudes so that they are able to produce sustainable architectural designs.

Keywords: Eco-friendly design, project-based learning (PjBL), city architecture, settlements

INTRODUCTION

The pace of urbanisation and technological innovation in the Fourth Industrial Revolution (4IR) era never stops [1]. Energy consumption and carbon emissions are getting bigger, especially in big cities. Therefore, it is very important to build healthier cities with the aim of maintaining global climate balance. A healthy city must have a comfortable and spacious green open space [2]. City parks contribute to supporting the health of residents and reducing the risk of chronic disease, because they provide comfortable and pleasant spaces for physical exercise and relaxation.

To create a beautiful city park with adequate facilities, various parties need to be involved, especially reliable architects. Architecture students are a major force in the design and construction of future urban landscapes. Therefore, it is very important to raise environmental awareness among students, especially architecture students.

The driving factor for environmentally friendly/caring behaviour is the awareness of environmental issues and specific measures to achieve environmental sustainability. Caring for the environment is manifested through knowledge, moral values and an attitude of loving the environment [3]. The values of caring for the environment have a positive effect on behaviour. Lack of knowledge may lead to a reluctance to participate in sustainability-oriented activities and measures, and can contribute to environmental damage, and possibly exacerbate global warming.

Students are a future asset to continue the battle of environmental preservation. Higher education is a means to achieve this goal, therefore it is necessary to prepare adequate infrastructure and competent human resources. In addition, strategies and learning models are also needed that are able to foster an attitude of caring for the environment. Learning must be student-centred, so that an understanding of the knowledge and skills needed can be obtained optimally [4][5].

Recently, many institutions in Indonesia are ready to contribute to forming a smart and environmentally conscious society, but only a few of these institutions are truly ready to provide an adequate curriculum. It is especially important for educational institutions that offer courses leading to a degree in architecture, as they are faced with challenges that are increasingly complex and sophisticated. It has to be noted, however, that some educational institutions, especially engineering and vocational colleges, do not always prepare students to face these challenges. Therefore, arises the importance of educational institutions to provide professionals and prospective future architects with the knowledge and skills of environmentally friendly designs.

Economic demands, especially the profit factor, forced developers to put aside environmental factors. However, when reviewed for further, long-term benefits, the concept of environmentally friendly design is far more profitable from an economic point of view. Because it can be easily maintained, does not violate natural laws, prevents disasters, uses recycled and green materials, and minimises the use of hazardous materials [6].

Considering that the global environment is not doing well requires architects to immediately switch from the 19th Century architectural education model to an educational model that is relevant to current climate conditions, in order to be able to present solutions and overcome community anxiety.

Climate change is a global concern today, hence various educational approaches incorporate the environmental aspects and climate change into their curricula all over the world, architecture education is no exception. Also, various strategies have been employed to achieve sustainable education goals, either through additional training, private courses or integrated learning models [7].

All of these efforts are expected to increase awareness of the importance of caring for the environment by students as future architects. For example, in the urban and residential architectural design class at the STIKMA International College of Technology, East Java Province, Indonesia practice-oriented teaching and learning methods are used to foster knowledge about the environment, which enables analysis of related problems at the observed research sites with an aim to finding solutions in the form of appropriate designs.

With the increasing concern of the world community for environmental issues, environmentally friendly design will be the main focus in every project undertaken by professional architects [8]. Therefore, students in the field of architectural studies who will become professionals in the industry, need a lot of opportunities and experience to consider environmental and climatic conditions in urban planning and green space design work in the future.

The presence of a people-friendly and ecological urban environment requires awareness of environmental care from all parties, especially educational institutions as providers of conscientious graduates, including professional architects in the future. Learning models that apply the concept of learning by practice have been widely used in architectural design studios, but in some countries are still rarely used at project sites directly [9].

City architecture and settlements have their own uniqueness and complexity, so conventional/lecture learning methods must be switched to a practice-oriented learning approach [10]. More focus should be placed on community needs and learning linked to current environmental issues. Therefore, the project-based learning (PjBL) model has been widely adopted to achieve these learning objectives. This strategy is often used in combination with collaborative learning, which is important in maximising student learning and fostering a high attitude of responsibility [11]. The purpose of the research presented in this article is to foster environmental care behaviour with sustainable design through project-based learning.

METHOD

The participants in this study were students who programmed within urban and residential architecture courses at the STIKMA International College of Technology, East Java Province, Indonesia. Project-based learning about eco-friendly awareness was applied to, and design skills acquired by 23 students. The course lasts for 16 weeks, and students had to pass several prerequisite courses, such as a basic computer course and an architectural design course.

In this study, students were observing activities on the Malang city square, then conducting a needs analysis and continuing with redesign. Students were expected to identify problems in the town square of Malang, analyse these problems and find a solution in the form of a city square reconstruction design.

The following are the stages of learning activities in this study using the PjBL approach.

Phase one lasted for two weeks (four hours of lessons). At this stage, students were assigned to conduct a survey of the city square of Malang, East Java Province, Indonesia, in September and October 2022. The area is a green open space located in the downtown area of approximately three hectares.

The objectives of assigning students to this survey included improving their understanding of environmentally friendly and non-environmentally friendly visitor behaviour. Students were also assigned to carry out a physical review of the Malang city square space because in the next stage they were expected to redesign this square. To facilitate the activities, 23 students were divided into five groups, with four or five members in each group.

Phase two lasted for two weeks (four hours of lessons). At this stage, students were asked to analyse functional aspects, circulation and undertake time analysis, to be applied in their redesign plans. Students were asked to integrate their design ideas with knowledge related to the environment that had been obtained from field observations.

The resulting design idea was followed by working on drawings in stage three. At this stage students needed to consider creativity, function, applicability and standardisation of designs, and also whether their designs could convey an eco-friendly design philosophy to others.

Stage three lasted ten weeks (20 hours of lessons). At this stage, students began to draw/redesign the park they had reviewed. Design ideas approved by the lecturer in charge of the course were transformed into working drawings that were followed by three-dimensional drawings. Three-dimensional design was needed, so that the important components that affect environmental sustainability could be clearly visible. This design activity trained students to deal with real-life problems that they may encounter in their future design practices, such as determining design concepts, design schematics, developing designs and creating drawings. The project in this course required students to use environmentally friendly design methods in their architectural designs. The three phases of the project were interconnected.

Evaluation was carried out to assess student performance in the project stages. Professional architects were invited from local architectural firms to assess and analyse student performance in the three phases of the project module, together with lecturers and students. Evaluation is important to get feedback from tutors and peers, so that it encourages students to improve their performance in the next stages of the project. Discussions between students and tutors can increase the understanding of professional knowledge in the process. It was expected that the PjBL approach used in the urban and residential architectural design class would help to increase students' environmental awareness.

RESULTS AND DISCUSSION

From the observation results, three types of environmentally unfriendly behaviour were found; namely: damaging vegetation, damaging public facilities and damaging environmental quality, as shown in Table 1 below:

Table 1: Investigated unfriendly behaviour.

No.	Environmentally unfriendly behaviour	Specific behaviour	Number of visitors
1	Damaging vegetation	Trampling of grass and plants	232
		Breaking and uprooting plants	11
		Sticking flyers on trees	2
		Scribbling on trees	0
2	Damaging public facilities	Damaging park facilities (chairs, garbage bins, playgrounds and sports facilities)	14
		Damaging the road (selling in the street area)	32
		Damage to guardrails	4
3	Damaging environmental quality	Reckless smoking	18
		Spitting anywhere	8
		Throwing garbage	42
		Scribbling on walls	7
		Noisy behaviour	15
		Pasting leaflets on walls	2
		Abandoning animals	7

Environmentally unfriendly behaviour is most prominent in damaging vegetation, especially trampling of grass and plants. In the town square, it is not allowed to step on the grass as it affects its growth. However, during their investigation, students found children running, sitting on the grass and playing in the garden. The observations also show that the road is widely used as a place to sell, the traders occupy almost the entire entrance area of the square, thus disturbing the visitors.

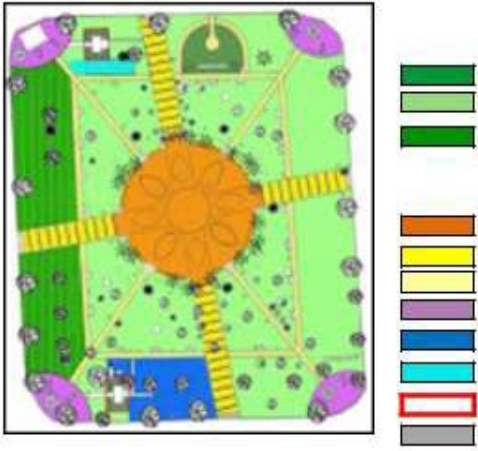
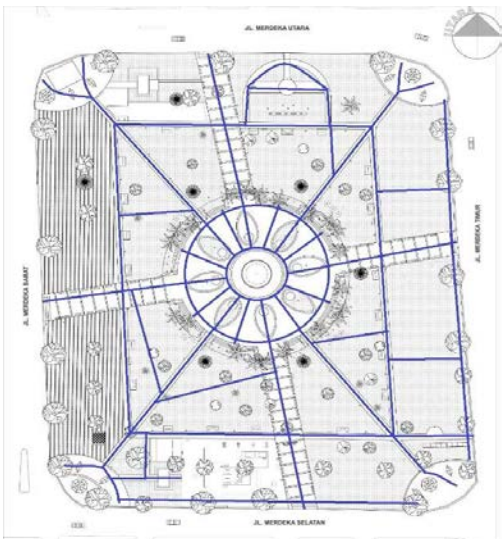
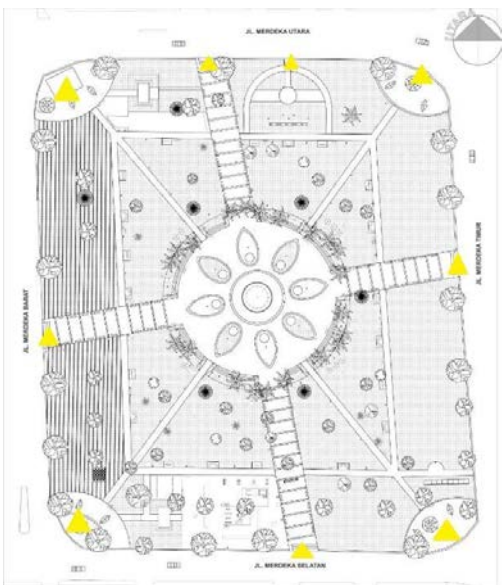


Figure 1: Observations in the town square.

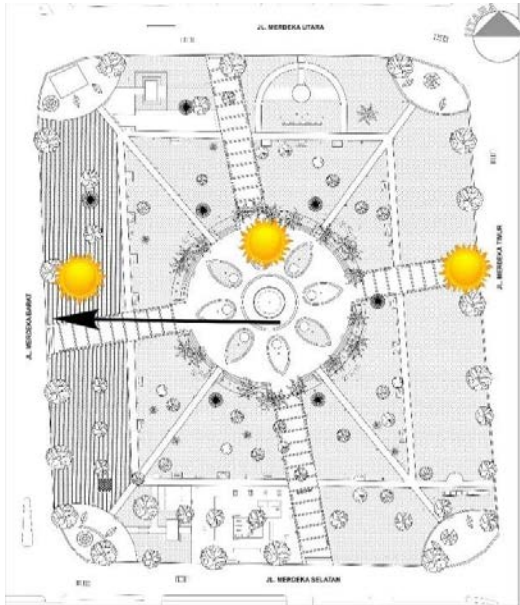
Even though there is a notice board, it does not have a positive effect on visitor behaviour. Good management is needed to keep the park clean and well maintained [12]. In this study, students also analysed environmentally friendly design methods used in the city square. The use of environmentally friendly methods in urban green space design can significantly protect and improve the quality of the surrounding environment [2]. These methods include using recyclable, locally produced materials, growing native plants and bulletin boards.

In phase two of the PjBL activities, students conducted an analysis of functional aspects, circulation, and carried out time analysis, with the following results:

Table 2: Analysis results.

Zone map	
	<p>Information</p> <ul style="list-style-type: none"> Sterile green zone presence of activity Activity-free green zone Green zone that is used as a place for prayer Plaza or centre Great pedestrian paths Small pedestrian paths UKM zone Playgrounds Skate park Toilet Garbage facility
User circulation patterns	
	<p>Circulation pattern of visitors who do not use the facilities that have been provided, but use facilities not intended for them</p>
Visitor login access	
	<p>Visitors can enter on all sides through nine doors made available for entry</p>

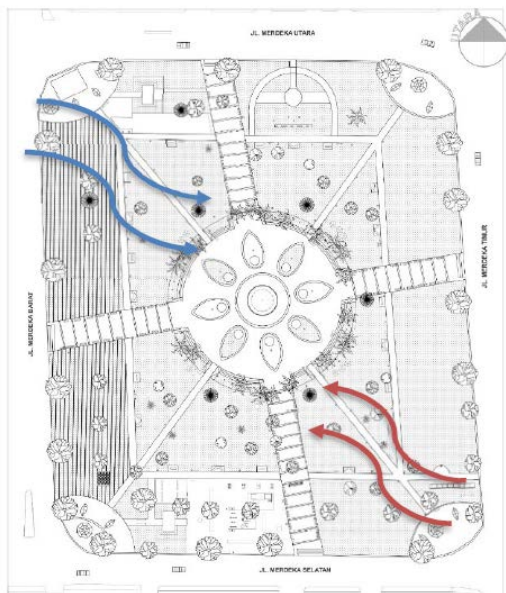
Sunlight



Analysis

- The sun shines all day on the north position
- The most sunny and hot is the east and west area because there are no tall buildings that would provide shade
- At noon, the main square area has a high heat level because it is open

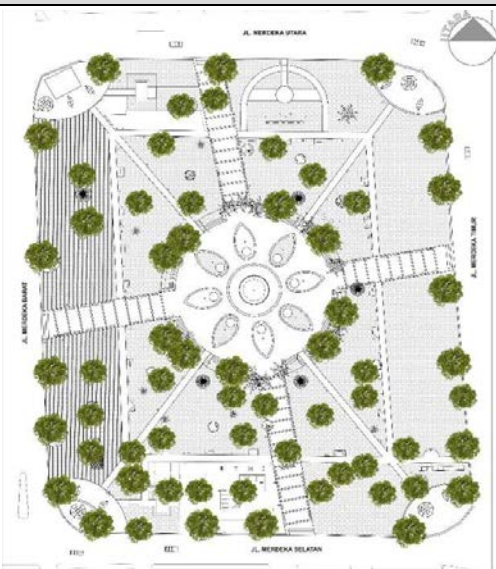
Wind direction



Analysis

- In April-October the wind blows from southeast to northwest
- In December-April the wind blows from the northwest to the southeast
- Analysis of the cardinal directions is needed to determine the location of trees and supporting buildings, so that visitor comfort is maintained, and it can also save energy and costs

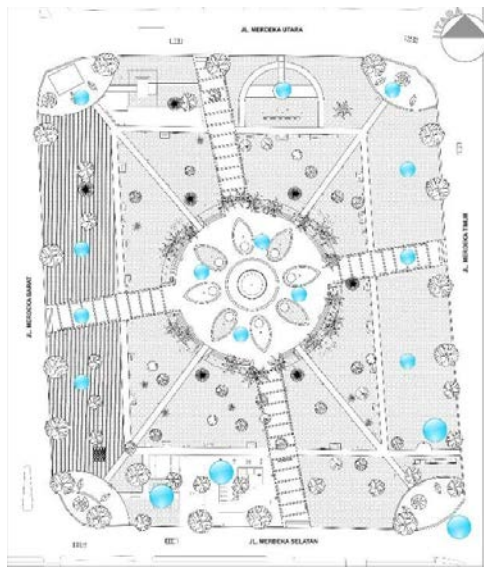
Vegetation



Analysis

- There is diverse vegetation in the square area, creating shade in existing public facilities
- A tree with a narrow crown in width and high density can control the wind
- There are trembesi, ketapan, cambodia trees and other ornamental plants

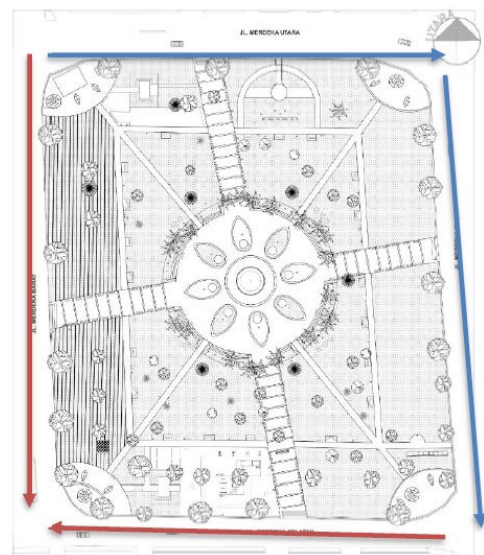
Water sanitation



Analysis

- The Malang city square has a control box and other points are located in vulnerable areas prone to waterlogging
- It has good water sanitation and disposal connected to the city system

Noise



Analysis

- Graded noise that is quite high comes from the main line of dense traffic
- Graded noise that is quite low is due to the lack of vehicles passing through the road

The results of this analysis were later used as a reference in redesigning the Malang city square, so that the redesign incorporated an environmentally friendly concept with adequate capacity for visitors. Creativity is always needed to produce a unique and sustainable design. The correct use of functions and the application and standardisation of designs need to be considered, so that the designs created could convey an environmentally friendly design philosophy to others.

Next was the design stage. Table 3 shows the appearance of the Malang city square before and after the redesign. This design is based on the results of observations and analyses undertaken by the students.

Architecture students are future professional architects and should have a major influence on sustainable development [13]. Therefore, an extra effort is needed to increase and deepen their awareness to protect the essence of sustainable development or environmentally friendly design. Eco-friendly design will help students to collect and summarise knowledge about climate and build sites for green open spaces; it will also enable them to analyse sites and identify possible climate-related problems, as well as to come up with design solutions that are environmentally friendly [7].

The architect is a complex and interdisciplinary profession [14]. Architectural education should be based on knowledge of the natural sciences, including ecology, engineering design, construction, botany, etc [15]. To better understand environmentally friendly design methods, students need continuous assistance, not only from lecturers in charge of the course, but also from construction industry experts, colleagues, family and the wider community. These external tutors are beneficial for architectural education, considering that they can transfer much more professional experience to students. Tutors from architectural firms can provide eco-design methods and cases, and remind students of the many details of project implementation from a construction perspective in real-life projects.

Table 3: Appearance of the city parks before and after the redesign.

Original view of the Malang city square	Redesign results
	
	

CONCLUSIONS

Based on the results and discussion above, several conclusions can be drawn as follows:

- 1) through the PjBL approach, student teamwork skills are improved, and students are able to communicate ideas and discuss them among group members in solving problems and achieving project goals;
- 2) the implementation of PjBL in urban and residential architecture courses fosters an attitude of concern for the environment through observation, analysis and design;
- 3) It is hoped that after becoming professional architects, students will continue to adhere to the principle of always caring about the sustainability of the environment and global climate, and will be creating architectural designs that are environmentally friendly (sustainable design).

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BIOGRAPHIES



Sulistianingsih As is a student in the Vocational Education Doctoral Programme at the State University of Malang in Indonesia. She earned a Bachelor of Education degree in building engineering education in 2010 and a Master of Education in the vocational education programme in 2014 at the State University of Malang. Apart from her studies, she is a lecturer at the International STIKMA College of Technology in Malang. She is currently working on a dissertation on soft skills assessment models, which supports the effectiveness of hybrid learning in tertiary institutions.



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